AMERICAN

DYESTUFF REPORTER

Volume 47 March 24, 1958 Number 6

RECENT WORK ON THE MECHANISM OF THE THERMAL DEGRADATION OF CELLULOSE* —A Review of Work Sponsored by the QMC—

ROY C LAIBLE
Textile, Clothing & Footwear Div
Quartermaster Research & Engineering Center, US Army
Natick, Mass

Recent research work on the mechanism of the thermal degradation of cellulose is reviewed with emphasis on the practical application of this information. A theory was postulated in which levoglucosan was the important intermediate in the thermal degradation of cellulose responsible for the flaming reaction. Studies of the products of the pyrolysis and combustion of cellulosic materials added credence to the the theory. Modified cellulose materials were then prepared which, in accordance with the theoretical predictions, showed significant glow and flame resistance. The studies leading up to this development and the future course of work are reviewed in the light of current requirements for protection against flame and thermal hazards.

FOREWORD

DUE to the need for textile fabrics, which offer improved protection against flame and thermal hazards, the QMC has sponsored various research projects on the thermal degradation of cellulosic materials. The results of this research led to the development of several additive-type flame-retardant treatments and finally to actual modifications of the cellulose molecule itself. This report will attempt to summarize the steps leading to these developments and to point out the future course of work to be followed.

DISCUSSION

BACKGROUND——In the past fifteen years considerable effort has been expended in an effort to determine the mechanism of the thermal degradation of cellulose, cellulose derivatives, and of cellulose treated with flame-retardant compounds. Most of this research was conducted under the sponsorship of the U S Government by such agencies as the Quartermaster Corps, Navy, Department of Agriculture, Chemical Corps, and the Air Force. As a basis for this work, data were available on some of the products of the destructive distillation of cellulose. This very early work was not continued because of the complexity of the products and the variance in these products produced by different conditions of thermal degradation. Instead, the investigators were mainly concerned with determining major differences between the mechanism of the degradation of untreated cellulose and that of cellulose treated with various flame and glow retardants.

*Textile Functional Finishes Laboratory Report No. 162.

EARLY PYROLYSIS WORK——In the investigations conducted at Columbia University during World War II, it was found that flame-retardant-treated fabrics produced much smaller percentages of tars than that characteristic of untreated fabric. An inverse correlation was possible, although not absolute, between the amount of tar liberated from a fabric flame-retardant combination and the relative effectiveness of the retardant in slowing down or inhibiting completely the flaming reaction *(1)*. These results allowed one to screen flame retardants to some extent on the basis of their char/tar ratios.

A second difference in the degradation of treated and untreated fabrics was noted in the gas phase. Those treatments which furnished glow-retardancy to the fabric also produced a much different CO/CO_2 ratio in the gas phase. Even 1% of an effective glow retardant reduces the CO_2 evolution from 2.5 to 0.8 grams per gram of char when samples so treated are pyrolyzed at 550°C *(1)*. Parks and coworkers at the University of Rhode Island found that effective glow retardants markedly altered the CO/CO_2 ratio in the gaseous products of decomposition as shown in Table I.

TABLE I

Treatment	*% CO_2*	*% CO*	*Ratio CO/CO_2*
Blank-untreated fabric	12.1	1.3	.11
Sodium tetraphosphate	4.0	16.0	4.0

Sodium tetraphosphate inhibits afterglow when applied to fabric. This apparent correlation between the CO/CO_2 ratio and the glowing phenomenon can be explained thermodynamically by the use of the heats of formation of carbon monoxide and carbon dioxide.

	Heat Evolved
$C + O_2 \longrightarrow CO_2$	94.4 Kcal
$C + \frac{1}{2} O_2 \longrightarrow CO$	26.4 Kcal

It appears that the heat liberated from the incomplete combustion of carbon to carbon monoxide favored by good glow retardants is not sufficient to sustain the glowing reaction.

DEVELOPMENT OF FLAME RETARDANTS —— Many inorganic materials were investigated for their flame-retardant properties as determined by these two criteria and by their actual performance. The problem was then one of producing a permanent treatment incorporating the constituents producing these desirable effects of flame retardance and glow resistance. One method of accomplishing this objective was to incorporate the better inorganic agents in a binder which could be applied to the cloth. A second method involved attachment of the flame-retardant groups to the cellulose molecule itself. This method usually resulted in excessive degradation to the fabric. The third most successful method involved the application of phosphorus

polymers to the cloth. As these polymers were organic they possessed the disadvantage of producing more tars than their inorganic analogs. To combat this deficiency, bromine was introduced so that, if the production of tars was not limited sufficiently, at least these tars would be rendered less combustible. Flame retardants such as brominated polymerized triallyl phosphate and triallyl phosphate — bromoform emulsion polymer were developed on this basis. In addition, other phosphorus polymers were developed, which, apparently, did not require bromine, such as Phoresin III and THPC. These developments and the development of other related flame retardants have been discussed in detail in papers by McQuade of the Quartermaster Corps *(14, 15)*.

SOUTHERN REGIONAL RESEARCH LABORATORY THEORY ——Reid, Schuyten, and Weaver at the Southern Regional Research Laboratory were dissatisfied with the theoretical aspects and explanations of flame retardancy. Although flame retardants were known to decrease tar formation, there was no one chemical theory to account for this fact. For this reason the group at Southern Regional Research Laboratory postulated a theory of dehydration and accelerated gas production *(11)*. The first portion of this theory is based on the knowledge that the most favorable degradation path would would be dehydration to water and carbon as illustrated by the following equation:

$$(C_6H_{10}O_5)_x \xrightarrow[\Delta]{} 6C + 5H_2O.$$

The strong Lewis acids necessary for dehydration by a carbonium ion mechanism would be formed by the flame retardant at the temperature of burning cellulose. There is evidence for this portion of the theory in that many effective flame retardants liberate Lewis acids and/or dehydration catalysts at flaming temperatures. A list of agents used as Friedel Crafts catalysts (usually Lewis acids) includes many compounds effective as flame retardants. For example, phosphoric acid, zinc chloride, titanium tetrachloride, titanium trichloride, and aluminum bromide have been used as Friedel Crafts catalysts. Many of these same agents entered into flame retardants used at one time or another. Zinc chloride and phosphoric acid may be used directly as flame retardants. As further evidence of this theory, Esteve and coworkers at the University of Rhode Island found that water was formed in greater amounts from the pyrolysis of cloth samples treated with an effective fire retardant than in the case of cloth which was untreated or treated with an ineffective flame retardant *(16)*. Table II illustrates this point.

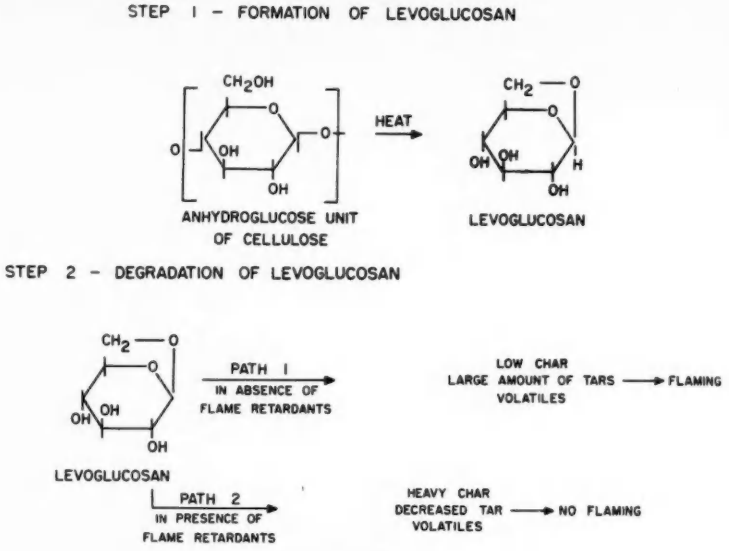


Figure 1
Levoglucosan theory

TABLE II
Water content of volatile products from the pyrolysis of cotton cloth at 400°C

Additive	*Water in volatile products* (%)	*Flame-retardant properties*
None-untreated	18	none
19% Brominated TAP	33	good to excellent
14% TAP-$CHCl_3$ (chain transfer polymer)	30	good
7% Diallyl melamine	19	none

The second portion of this theory, accelerated gas production, is based on the relative rates of degradation of untreated and flame-retardant-treated fabric. Fabric treated with an effective flame retardant degrades at a much more rapid rate than untreated fabric and as a consequence the volatile products are liberated in more concentrated form. It is postulated that this high concentration of volatiles (flammable or nonflammable) inhibits the flaming reaction. This theory is credible because many authors have shown that inflammable gases are often not flammable when present in high enough concentrations, especially when halogen-containing molecules are also present *(23, 24, 25)*. An additional factor is that the volatiles from flame-retardant-treated cellulose are given off at a lower temperature, which may be below the ignition point *(30)*.

A REAPPRAISAL OF THE PROBLEM——Two or three years ago it was decided that the work on the development of flame retardants suffered from two deficiencies. The first was that flame retardants which possessed desirable properties in flame tests and under usual flame hazards possessed much less desirable properties under high-energy, very fast degradations. It was further found that these flame-retardant-treated fabrics, which possessed favorable char/tar ratios under long-time degradations, produced considerably more tars as the rate of degradation was increased. These tars, although of limited flammability, may have aided the transfer of considerable heat through a fabric system to the skin adding to the burn produced.

The second deficiency was that the mechanism work that had been conducted was no longer leading to newer-type fire retardants. Instead, selection was made empirically by testing various resinous phosphates for permanency and ease of application. It was thought that fundamental knowledge of the actual mechanisms involved in the pyrolysis and combustion of cellulose would be required in order to prepare better flame retardants. For both objectives the best approach would be to determine the amount and chemical nature of the products from the degradation of untreated and flame-retardant-treated cellulose.

Several contracts were obtained with educational and scientific installations to cover various approaches to these problems. The contractors included Textile Research Institute, University of Pennsylvania, University of Rhode Island, National Bureau

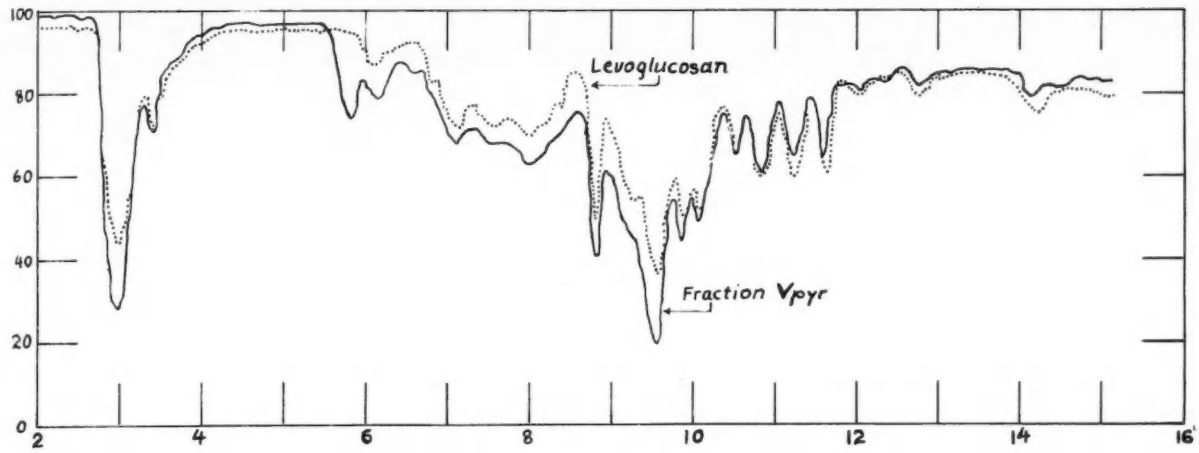


Figure 2
Infra-red spectra of tar fraction, V_{pyr}, and of levoglucosan

of Standards, and Southern Regional Research Laboratory. These approaches included studies under aerobic and anaerobic conditions, using fast and slow rates of degradation. The principal accomplishments of this contract work follow.

EFFECT OF RATE OF DEGRADATION——The group at the University of Rhode Island found that the char/tar ratio characteristic of a given flame-retardant treatment was not a constant figure. As the rate of degradation was increased, the amount of tar produced also increased and the amount of char or residue remaining decreased *(20)*. The results obtained from the degradation of three fire-retardant treatments are given in Table III.

TABLE III
Effect of rate of degradation upon char/tar formation

	Furnace block decomposition				*Radiant energy* (6 secs)	
	Slow 400° C		*Fast 400° C*			
	Char	*Tar*	*Char*	*Tar*	*Char*	*Tar*
Untreated	21%	46%	18%	50%	9%	44%
Brominated TAP	41%	18%	34%	38%	18%	40%
THPC Phoresin III	49%	17%	44%	20%	30%	28%
	51%	16%	45%	21%	27%	33%

The radiant energy decompositions were conducted using a tungsten lamp source capable of delivering 5.3 cal/cm²/sec and a flow of nitrogen equal to 2600 cc/min. The tars from the degradation of 25 replicate samples were combined in each run. Chars given are also the average of 25 samples *(20)*. This information was considered to be a possible explanation for the previous field observation that flame retardants which proved to be satisfactory for thermal hazards of long duration were not completely satisfactory for protection against the more modern thermal hazards of short duration.

The same treatments which were evaluated at the University of Rhode Island, using the tungsten lamp heat source, were also degraded at the Quartermaster Laboratories in Natick using the carbon arc. The brominated TAP treatment was found to give the lowest temperature rise under the conditions of testing. The amount of tar driven through the fabric to the backing or underlayer was also lower for this treatment *(22)*. This work illustrates the importance of the heat transferred by the tarry distillate from the degradation of flame-retardant-treated cellulose on the thermal protection problem.

LEVOGLUCOSAN THEORY——Another important result of this contract work was the crystallization and partial confirmation of a theory of the thermal degradation of cellulose advanced by Esteve and his coworkers *(2)* at the University of Rhode Island based upon the general mechanism proposed by Tamaru *(34)*. This theory was based on the importance of an intermediate and final product of the degradation of cellulose, levoglucosan, which was thought to be the principal source of the combustible products from the degradation of cellulose *(2)*. This compound, 1,6-anhydro-B-D-glucopyranose, had previously been shown to be a pyrolysis product of pure cellulose as far back as 1918 by Pictet and Sarasin *(3)*. Esteve and Gollis found that, in the presence of a flame retardant, authentic samples of levoglucosan were thermally degraded to a heavier char than when the levoglucosan was degraded alone *(2)*. It was proposed by Pacsu and Schwenker of Textile Research Institute *(8, 17)* that, instead of using an additive treatment to catalyze the degradation of levoglucosan to char, it might be advantageous to determine the possibility of chemically modifying the cellulose so as to inhibit the formation of this intermediate altogether. The so-called levoglucosan theory is shown diagramatically in Figure 1.

TABLE IV
Degradation products of untreated cellulose

Fraction	*Composition*
V_{pyr}	tar
V_{25}	86% water, 12% formaldehyde, 1% methanol, 1% acetone
V_{-80}	CO_2
V_{-190}	CO

EXPERIMENTAL WORK SUPPORTING THEORY——In order to investigate this theory outlined in Figure 1 and to practically apply the results to the preparation of fabric possessing flame and glow resistance, it was first necessary for the Textile Research Institute group to develop a satisfactory method of analysis for levoglucosan. Untreated cellulose was thermally degraded at temperatures from 350-370°C using an oxidizing atmosphere of 180-200 cc of air per minute. The products were collected at 0°C. Several products previously unreported were found, including formaldehyde, glyoxal, glycolic acid, lactic acid and either formic or acetic acid. The major products were water and levoglucosan. The levoglucosan was qualitatively determined using paper chromatography and comparing the Rf value* of the unknown with that of an authentic sample of levoglucosan. For quantitative determination, the levoglucosan was converted to D-glucose by hydrolysis with dilute sul-

*The Rf value = $\frac{\text{Distance travelled by component}}{\text{Distance travelled by solvent front}}$

furic acid, isolated by paper chromatography, and finally determined by iodimetric titration. The average amount of levoglucosan obtained from the pyrolyzates was 12.5%. The presence of levoglucosan in the pyrolyzates was confirmed by studies which were conducted at the National Bureau of Standards at the same time. Untreated cellulose was pyrolyzed in a vacuum and the products separated into various fractions. These fractions were designated as volatile at the temperature of pyrolysis (V_{pyr}), volatile at 25° (V_{25}), volatile at —80°C (V_{-80}), and volatile at —190°C (V_{-190}). The approximate composition of these fractions is given in Table IV.

The tarry fraction, V_{pyr}, was shown to be principally levoglucosan by means of molecular-weight determination and infrared analysis. (Figure 2).

Oxidized cellulose was first pyrolyzed in air at Textile Research Institute. Oxidized cellulose is prepared from the oxidation of cellulose with nitrogen tetroxide, which results in the oxidation of the primary alcohol group at the No. 6 carbon of the anhydroglucose unit of cellulose to carboxyl. (Figure 3A). According to Pacsu and Schwenker (*8, 17, 35*), such a modification would be expected to block the formation of levoglucosan so that a different mechanism of degradation would become operative. Pyrolysis of oxidized cellulose in vacuum was subsequently studied at National Bureau of Standards. The results obtained from both groups confirmed the proposed effect of such modification. Pacsu and Schwenker at Textile Research Institute found that the percentage of levoglucosan in the pyrolyzate was decreased from 12% to 5% when 50% of the primary hydroxyl groups of the anhydroglucose units of cellulose were converted to carboxyl groups. Madorsky at National Bureau of Standards thermally degraded oxidized cellulose in a vacuum (Figure 3B), collected all the fractions, and found that the ratio of flammable products to those which would normally be considered unlikely to burn was greatly decreased. The chemical nature of the volatile products was determined with the help of the mass spectrometer. The results obtained with both untreated cellulose and oxidized cellulose are shown in Table V.

The comparison shows a ratio of $\frac{67}{33} = 2.0$ for untreated cellulose and .11 for oxidized cellulose (*6*). The exact ratios found are not strictly comparable due to differences in the extent of degradation but the lowered amount of flammable products from oxidized cellulose is unquestionable.

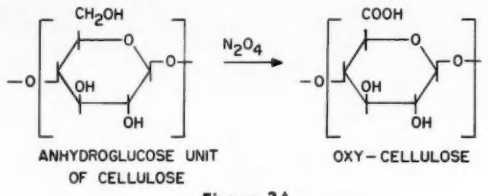


Figure 3A
Preparation of oxidized cellulose

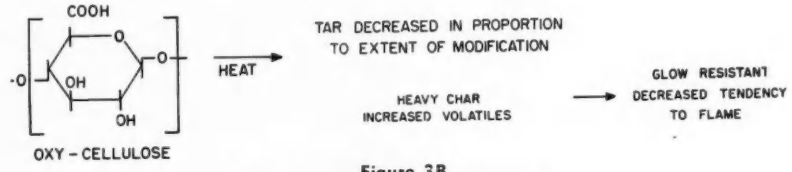


Figure 3B
Thermal degradation of oxidized cellulose

TABLE V
Comparison of degradation products from untreated cellulose with those from oxidized cellulose

	Flammable		Not Flammable	
	T_{ar}	CO	H_2O	CO_2
Untreated Cellulose	65%	2%	27%	6%
Oxidized Cellulose	6%	4%	51%	39%

OTHER APPROACHES —— An entirely different approach to the problem of determining the mechanism of the thermal degradation of cellulose was taken by Krieger and Day under a contract held by the University of Pennsylvania. They directed this work toward dual goals of identifying the early products from the degradation of cellulose and of determining whether the nature of these products changed as the rate and temperature of degradation were altered. In other words, are the early products from the degradation more likely to be free radical in nature when the cellulose is decomposed very quickly, and ionic in nature when a result of slow thermal degradation? In this connection, the following approaches to the problem of the mechanism of the thermal degradation of cellulose were taken at the University of Pennsylvania (*26, 27*).

Attempts were made to decompose threads of untreated and flame-retardant-treated cotton fabric in a matter of seconds by means of a hot resistance wire (*26*). The early fragments, if free radical in nature, were to be trapped with the radioactive iodine which coated the inside walls of the glass apparatus. The pressure in the system was reduced sufficiently to ensure reaction between the free radical fragment and the iodine rather than any competing reaction. After reaction, a mixture of the alkyl halides suspected to be present was added to the radioactive iodides to act as carriers, the excess iodine destroyed, and the mixture fractionally distilled. The activity of the various fractions was then determined as indicative of the amount of free radical fragments originally formed. From the resultant activity in the fractions, it appeared that vinyl, methyl and ethyl free radicals were among the early products of pyrolysis. However, it was later determined that the amount of thermal degradation was slight and that exchange reactions between the radioactive iodine and the alkyl halides accounted for most of the radioactivity. The first deficiency could have been surmounted by the use of a radiant heat source to accomplish rapid thermal degradation but the predominance of exchange reactions would have made it necessary to develop an entirely different method of trapping the radical fragments. Because of the preceding difficulties this portion of the project was dropped.

Gas chromatography was utilized as the second technique for determining early products from the degradation of cellulose. The cellulose was pyrolyzed at 450°C in an atmosphere of nitrogen, the products passed through a silica gel column at 140°C and detected by their heat of adsorption with an activated charcoal detector tube. The major product detected was water, which amounted to 75% of the water of constitution of the cotton decomposed (*27*). Dehydration would thus appear to be the major reaction under anaerobic pyrolysis conditions. However, the thermal degradation of flame - retardant - treated and untreated cellulose under oxidizing conditions corresponds to the usual situation encountered in the field and the value of the preceding work lies in the possible application of gas chromatography to the identification of volatile degradation products.

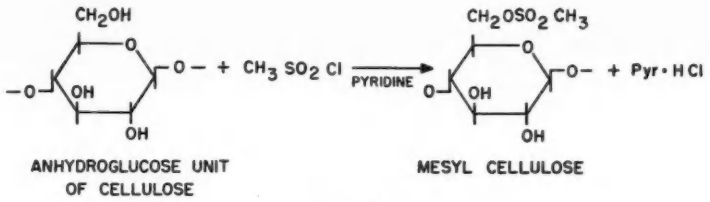


Figure 4A
Preparation of mesyl cellulose

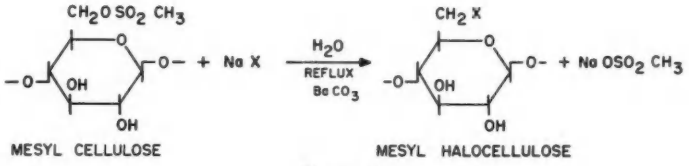


Figure 4B
Preparation of mesyl halocellulose

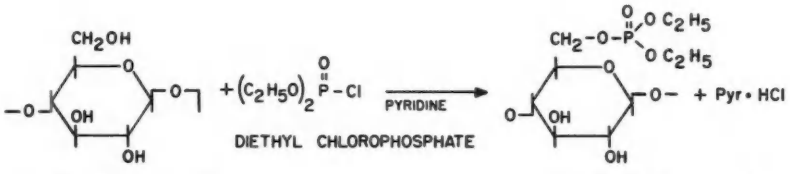


Figure 5A
Phosphorylation of cellulose

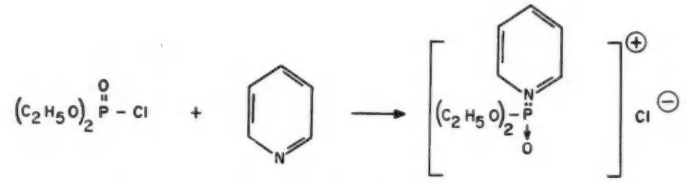


Figure 5B
Proposed mechanism—formation of pyridium complex

PRACTICAL MODIFICATIONS OF CELLULOSE —— Historically, the chemical modification of cellulose fabrics to effect flame resistance had previously been conducted at Columbia University (*31*). Cotton was etherified with 2-aminoethyl sulfuric acid in alkaline solution and subsequently phosphorylated to provide flame and glow resistance with a relatively low-weight increase. The disadvantages of this and related modifications were loss in fabric tearing strength, excessive shrinkage, and susceptibility of the treated fabric to ion exchange (*32, 33*).

The results of the pyrolysis of untreated cellulose and of oxidized cellulose discussed in previous paragraphs have shown that the amount of levoglucosan formed is greatly decreased in the latter case. As levoglucosan is thought to be the major source of flammable products from the thermal degradation of cellulose, this finding was a clue to the preparation of modified cellulosic materials possessing flame-retardant properties. Due to its solubility in aqueous alkaline solutions, oxidized cellulose could only serve as a theoretical example of the type of modification desired and steps were taken to obtain more practical products. The Textile Research Institute was selected for this work because of the wide experience of personnel in the field of cellulose modifications. Pacsu and Schwenker of Textile Research Institute worked on several methods of cellulose modification and finally developed a method of reacting cotton cellulose cloth with methane sulfonyl chloride in pyridine to produce a mesyl cellulose. The reaction is shown in Figure 4A.

Modifications of this type had previously been conducted only with cotton linters or cellulose acetate materials (*9*). The mesyl cellulose was found to possess decreased flammability and improved glow resistance without any apparent deleterious changes in the physical properties of the fabric (*7*).

The damping action of halogen on flaming is well-known and has been effectively used in commercial fire extinguishers. The effect of halogen with respect to the flaming of textile materials was studied by Church in 1943-1945 (*1*). A bromine-containing resin was later shown to be an effective flame-retardant finish (*36*). The halogen effect has also been discussed by Gottlieb in his consideration of theories of flame retarding involving additive finishes (*4*). Therefore, it was considered advisable to replace some of the mesyloxy groups with halogen atoms, such as bromine (*8*).

The reaction developed was a heterogenous one, which consisted of refluxing mesyl cellulose with a 20% aqueous solution of the sodium salt of the desired halide (*35*) (Figure 4B). The halide introduced can be bromine, iodine, chlorine or fluorine. As has been found with additive-type flame retardants, the effectiveness of the halides in imparting flame resistance is in the order I>Br>Cl>F. Good flame resistance was found when light or heavy weight fabrics were modified with bromine or iodine,

Flame resistance is not the only factor involved in the thermal-protection problem. The phenomenon of afterglow can liberate a considerable amount of heat leading to the production of burns. For some applications the mesyl and halo mesyl cellulose materials mentioned might have insufficient resistance to glow. From experience with additive-type treatments, it is known that the application of materials containing boron or phosphorus to fabric prevents afterglow. For this reason a phosphorylation reaction was investigated, which was analogous to the mesylation modification. An organo-halophosphate, diethyl chlorophosphate, was reacted with cellulose in the presence of pyridine as shown in Figure 5. (*35*).

Realizing the lack of practicability in any large-scale production of modified fabric for which a contact time of three to four hours was necessary, the personnel at Textile Research Institute experimented with different methods of phosphorylation. Improvement in the reaction was obtained by phosphorylating the previously mesylated cellulose. Reaction times as low as five minutes were found to be satisfactory with a molar ratio of 3 moles of diethyl chlorophosphate to 1 mole of the anhydroglucose unit of cellulose. Afterglow was eliminated in samples containing as little as .5% chemically combined phosphorus. This small percentage of

phosphorus necessary to achieve glow resistance is in accord with the catalytic theory of glow resistance previously advanced (*19*).

A combination of the treatments of mesylation, phosphorylation and halogenation results in modified cellulosic fabrics which possess good glow and flame resistance. The fabric properties seem unimpaired and the flame retardant properties are theoretically permanent.

FUTURE WORK———The modified cellulosic materials discussed in the previous section have been prepared only in small samples and many problems must be solved before they can be practically utilized. These problems include: the preparation of suitable equipment for pilot plant manufacture, the cost of materials, the recovery of pyridine, the possible effect of such modifications on fabric properties such as dyeability, and the extension of the testing to include exposure to actual flame and thermal hazards.

Part of the value of this modification work lies in its possible extension to other fields. If cellulose can be successfully modified to impart flame and glow resistance, it may also be possible to modify the cellulose molecule so as to impart other desired properties, such as water resistance, mildew resistance, dimensional stability, etc.

Despite the successful application of the latest theory of flame retardancy, we are still a long way from either the perfect flame retardant or an irrefutable theory of flame and glow retardancy. Too little is known about the products of the thermal degradation of flame-retardant-treated cellulose, as investigators have concentrated their efforts on the study of the degradation of pure cellulose itself. Specifically three items require study as follows:

1) The first item involves the gaseous products of combustion. What part does the bromine play in preventing flaming—just a nonflammable diluent or a chain stopper? If the latter explanation is true, it should be possible to find cheaper chain stoppers (free radical inhibitors) which would be just as effective.

2) The second is related to the tarry products which were the subject of a large portion of this report. Although it is known that levoglucosan, water, acids and carbonyl compounds are formed from untreated cellulose, much less is known about the composition of the tars from flame-retardant-treated cellulose.

3) The last item requiring study is the black residue which results when a flame-retardant-treated fabric is thermally degraded. What are the properties of this carbonaceous mass? Why does the presence of phosphorous or boron (in proper form) prevent the afterglow reaction? The explanation given in this paper was based on cause and effect while other more detailed explanations have been based at least partially on conjecture.

To fully exploit the thermal protection which flame-retardant-treated fabrics are capable of furnishing, it will be necessary to determine the heats of reaction involved. In this connection Feldman applied the technique of differential thermal analysis in an effort to determine which flame-retardant treatments tended to absorb rather than release heat when subjected to thermal stress (*29*). This work was not reported in the body of this report due to its preliminary nature. However, in the final analysis it would be necessary to determine not only the exothermicity of a particular fabric treatment, but also the distribution of the heat flow between that which adds to the thermal insult and that which is lost to the surroundings.

When the above knowledge becomes available, it is felt that considerable progress can be effected not only in the chemical development of flame-retardant treatments but also in improving their protective potential in the physical heat transfer system.

LITERATURE CITED

(*1*) Church, J (Columbia Univ), "Fundamental Studies of Chemical Retardants for the Fire-resistant Treatment of Textiles", Dept of the Army, Office of The Quartermaster General, Textile Series Report No. 38 (1952).

(*2*) Parks, W G; Esteve, R; Gollis, M; Guercia, R; and Petrarca, A, "Mechanism of the Pyrolytic Decomposition of Cellulose", Paper No. 15, Div of Cellulose Chem, Abstracts, 127th ACS Meeting, Cincinnati, O, (Mar 29—Apr 7, 1955).

(*3*) Pictet, A, and Sarasin, J, "Distillation of Cellulose and Starch in a Vacuum", *Helv Chim Acta* **87**, No. 1, 78-96 (1918).

(*4*) Gottlieb, I M (Textile Research Institute and Quartermaster Corps), "A Theory of Flame-retardant Finishes", *Textile Research J* **26**, 156-167 (1956).

(*5*) Madorsky, S; Hart, V; and Straus, S (National Bureau of Standards), "Pyrolysis of Cellulose in a Vacuum", *J Research NBS* **56**, No. 6, 343-354 (1956).

(*6*) Madorsky, S (National Bureau of Standards), "Thermal Decomposition of Cellulose", Reqn No. 49-106-046-55, Progress Report No. 4069, Quartermaster Corps Contract (Jan 1-Mar 31, 1956).

(*7*) Schwenker, R, and Pacsu, E (Textile Research Institute), "Pyrolytic Degradation Products of Cellulosic Materials", Paper Presented at Delaware Valley Regional Meeting, ACS, Feb 16, 1956, in print, *J Am Chem Soc*.

(*8*) Pacsu, E, and Schwenker, R (Textile Research Institute), "The Effect of Chemical Modification on the Flame and Glow Resistance of Cotton Cellulose", Letter to the Editor, *Textile Research J* **27**, 173-5 (1957).

(*9*) Wolfrom, M L; Sowden, J; and Metcalf, E, "Mesylated Cellulose and Derivatives", *J Am Chem Soc* **63**, 1688-91 (1941).

(*10*) Martin, S, "The Mechanisms of Ignition of Cellulosic Materials by Intense Thermal Radiation", Research & Development Technical Report US NRDL-TR-102, NS 081-001, (Feb 10, 1956).

(*11*) Schuyten, H; Weaver, J; and Reid, J D (Southern Regional Research Laboratory), "Some Theoretical Aspects of the Flameproofing of Cellulose", Advances in Chemistry Series No. 9, "Fire Retardant Paints", 7-20 (June 1954).

(*12*) Sauer, F M, U S Dept of Agriculture, Forest Service, Division of Fire Research, Calif Forest & Range Experimental Station, Berkley, Calif. Interim Technical Report AFSWP-869 (1955) (classified).

(*13*) Madorsky, S L (National Bureau of Standards), *J Polymer Sci* **9**, 133 (1952); **11**, 491 (1953).

(*14*) McQuade, A J (QM R&D Command), "Recent Work on Flame-Resistant Treatments for Textile Fabrics", Textile Functional Finishes Laboratory Report No. 147, (Sept 30, 1954).

(*15*) McQuade, A J (QM R&D Command), "Flame Resistance of Military Fabrics", *Am Dyestuff Reptr* **44**, No. 22, 749-751 (Oct 24, 1955).

(*16*) Esteve, R; Gollis, M; and Guercia, R (Univ of Rhode Island), "Brominated Triallyl Phosphate Polymer and Related Compounds for the Fire Resistant Treatment of Textiles", Office of the QM General, Contract DA44-109-qm-1414, Progress Report No. 11, pg 3 (Aug 1-Nov 1, 1953).

(*17*) Pacsu, E, and Schwenker, R (Textile Research Institute), "Oxidation of Flame-Resistant- and Nonflame-resistant-Treated Clothing", Progress Report No. 1, QM Contract No. DA19-129-qm-122 (June 10-Sept 10, 1954).

(*18*) Erhardt, J; Roberts, D; and Parks, W George (Univ of Rhode Island), "The Catalytic Oxidation and Degradation of Cellulose", Technical Report No. 2, Contract 8-mr-506 (Dec 1, 1948).

(*19*) Coppick, S (Columbia Univ), "The Kinetics of the Oxidation of Carbon as Related to the Afterglow Phenomenon", Final Report, Sub-Project 27-R12, NRC Project, QMC No. 27 (Oct 9, 1945).

(*20*) Gollis, M; Stetson, C; and Tilley, J (Univ of Rhode Island), "The Fire-resistant Treatment of Textiles", Office of the QM General, Contract DA19-129-qm-324, Progress Report No. 3 (June 4-Dec 3, 1956).

(*21*) Antoni, M; Petracca, A; and Pitochelli, A (Univ of Rhode Island), "The Catalytic Degradation and Oxidation of Cellulose", Final Report, Contract N8 ONr-506, Project NR-033-253 (June 30, 1953).

(*22*) Laible, R, and Cook, S (QM R&D Command), "The Influence of Degradation Products on the Thermal Protection Afforded by Flame-retardant-treated Fabrics", Textile Functional Finishes Laboratory Report No. 165 (Feb 1957).

(*23*) Burgoyne, J, and Neale, R (Imp Coll Sci Technol, London), "Some New Measurements of Flammability Ranges in Air", *Fuel* **32**, 5-16 (1953).

(*24*) Burgoyne, J, and Neale, R (Imp Coll Sci Technol, London), "Limits of Flammability and Spontaneous Ignition of Some Organic Fuels in Air", *ibid* **32**, 17-27 (1953).

(*25*) Coleman, E, "Effects of Fluorinated Hydrocarbons on Inflammability Limits of Combustible Vapors", *ibid* **31**, 445 (1952).

(*26*) Day, A; Washburne, R; Krieger, R; and Hobson, M (Univ of Pennsylvania), "Study of Early Fragments of Thermally Decomposed Cellulose and Changes Produced in Them by Flame Retardants", Contract DA19-129-qm-211, Progress Report No. 7 (Jan 1-Mar 30, 1956).

(*27*) Krieger, K; Hobson, M; Day, H; and Washburne, R (Univ of Pennsylvania), "Study of Early Fragments of Thermally Decomposed Cellulose and Changes Produced in Them by Flame Retardants", Contract DA19-129-qm-211, Progress Report No. 8 (April 1-June 30, 1956).

(*28*) Krieger, K, and Day, A, Private Communication (April 1, 1956).

(*29*) Feldman, D (QM R&D Command), "The Differential Thermal Analysis of Certain Flame-retardant-treated Fabrics", Textile Functional Finishes Laboratory Report No. 148 (Mar 2, 1955).

(*30*) Miles, T (QM R&D Command), "Thermal Decomposition of Flame-retardant-treated Cotton Fabrics", Textile Functional Finishes Laboratory Report No. 136 (April 5, 1954).

(*31*) Church, J (Columbia Univ), "The Flameproofing of Army Clothing", Complete Final Report Project QMC No. 27, National Research Committee on Quartermaster Problems—pp 84-92 (Dec 1, 1945).

(*32*) Cleary, L (Columbia Univ),"Fire-retardant Investigations of Phosphorylated Aminoethyl Cellulose Structures"—Thesis submitted as a partial requirement for the degree of Doctor of Philosophy (1954).

(*33*) Sherry, E (Columbia Univ), "The Ion-Exchange Susceptibility of Phosphorylated Cotton Fabrics"—Thesis submitted for MS degree (1954).

(*34*) Tamaru, K, "Pyrolysis and Combustion of Cellulose in The Presence of Inorganic Salts", *Bull Chem Soc Japan* **24**, 164 (1951).

(*35*) Schwenker, R F Jr, and Pacsu, E (Textile Research Inst), "Chemically Modifying Cellulose for Flame Resistance", *Ind Eng Chem* 50 91 1958).

(*36*) Frick, J G; Weaver, J W; and Reid, J D (Southern Regional Research Laboratories), "Flame-resistant Cotton Fabrics; An Emulsion Treatment Using An Organic Phosphorous Bromine Polymer", *Textile Research J* **25**, 100 (1955).

Proceedings of the

American Association of Textile Chemists and Colorists

Copyright, 1958, American Association of Textile Chemists and Colorists

March 24, 1958

36th Annual Convention———

TEXTILE PROCESSING CHEMICALS*

L D BERGER JR

Union Carbide Chemicals Co
A Division of Union Carbide Corp

"Textile Processing Chemicals" are chemicals consumed in the processing, dyeing and finishing of fibers into textile goods which cannot be identified to any appreciable extent on the finished textile article.

Progress in textile technology in recent years has brought about major growth and diversification in the consumption of textile processing chemicals, sales of which amounted to $390 million in 1955.

An analysis of the various categories of textile processing chemicals and their relative economic importance is presented. The future growth of textile processing chemicals is discussed, emphasizing the increasing importance of synthetic organic chemicals to the solution of textile processing problems. Synthetic warp sizes, solvent dyeing processes and antistatic agents are examples of recent textile processing chemical developments.

INTRODUCTION

TEXTILE processing chemicals are chemicals consumed in the processing, fabrication, dyeing and finishing of a fiber into a finished textile article, which cannot be identified to any significant extent on the finished article. Thus intermediates for synthetic fibers, dyestuffs, rayon raw materials, resin finishes and the like are not included in the products to be covered by this discussion.

In general, it has been a widely accepted truism that the textile industry is a major consumer of chemicals. Exactly how important this chemical consumption is in terms of dollars has been a question answered only in the broadest terms by both the textile and the chemical industries. This paper is an effort to evaluate quantitatively the types of chemicals used by the textile industry, the order of magnitude of their use and their relative economic importance. From this analysis of the past, one can then speculate in a limited way about the textile processing chemicals of the future.

The study on which this paper is based was initiated to gather data for presentation before an American Chemical Society symposium conducted by Milton Harris at the May, 1957 meeting of the ACS. The overall conclusions of that symposium were briefly summarized by the ACS publications. The detailed economic data developed on textile processing chemicals during this study were of unusual interest and, so far as is known, no similar analysis of textile chemical usage has been publisheed up to the present time.

A word of explanation should be given here as to the source and reliability of the numerical data to be presented. The basic data used for total U S chemical sales and textile industry use were derived from the Inter-Industry Relations Study published by the Bureau of Labor Statistics in 1947. This primary information was brought up to date and refined by reference to the other sources cited in the bibliography, as well as numerous trade publication articles and discussions with industry experts. The Business and Defense Services Administration of the U S Department of Commerce was most helpful in verifying some of the industry information. Relevant data from Union Carbide's sales and market research groups have been incorporated where applicable, and a certain amount of crystal-ball gazing has been necessary to combine the figures from all these sources into reasonably sound conclusions. The result of all this is a series of market estimates that may shed some light on the use of chemicals in textile processing.

* Presented November 15, 1957 in the Ballroom of the Hotel Statler, Boston, Mass. during the 36th National Convention of AATCC.

DISCUSSION

USE OF CHEMICALS IN TEXTILE PROCESSING———In 1955, total U S production of all chemicals was valued at $7.22 billion (Figure 1). The growth of the petrochemical industry is confirmed by the fact that this total is divided almost equally between petrochemicals ($3.71 billion) and all other chemicals ($3.51 billion). These figures represent the total of all basic chemicals produced in the U S during 1955 valued at the market prices in effect that year.

During 1955, the textile industry consumed a total of $2.3 billion dollars worth of all chemicals (Figure 2). Of these, $1.6 billion came from inorganic and nonpetrochemical sources, and $700 million were of petrochemical origin. It is important to define carefully how this figure was derived. The cost of all chemical products delivered to textile manufacturers or processors was used as the basis for the dollar values cited. Synthetic fibers are included in the total as chemical commodities and they are valued at the price paid for the fiber at the mill. The figure for total U S chemical production refers, of course, to basic chemical products, and so it is not accurate to infer that the textile industry consumes some 30 percent of all chemicals produced in the United States. For example, starch is included in the $1.6 billion in Figure 2, but is not included in the total of $7.22 billion worth of chemicals shown in Figure 1. On the other hand, synthetic fibers at the mill price are included in our textile industry consumption figures as chemicals, whereas the tonnage figure for total U S chemical production includes only monomers and other chemical raw materials for fibers, and excludes cellulose.

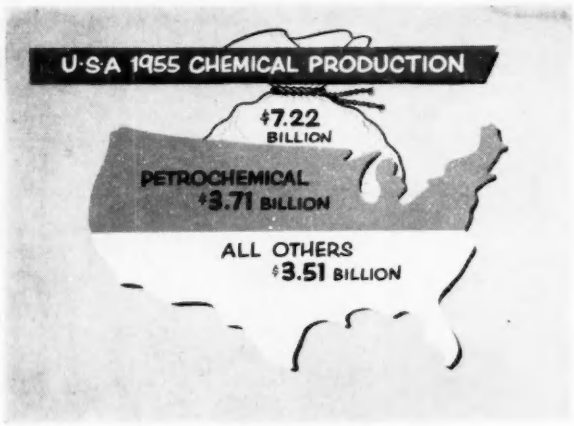


Figure 1

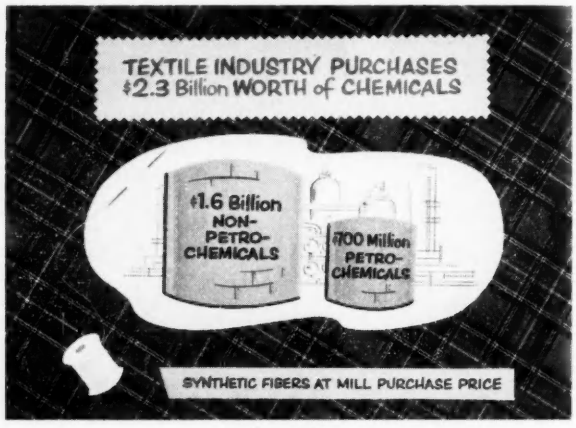

TEXTILE INDUSTRY PURCHASES
$2.3 Billion WORTH of CHEMICALS
$1.6 Billion NON-PETRO-CHEMICALS
$700 Million PETRO-CHEMICALS
SYNTHETIC FIBERS AT MILL PURCHASE PRICE

Figure 2

Figure 3

Figure 4

In Figure 3 is shown an estimate of the actual chemical consumption of the textile industry corrected to include only the chemical raw materials used to make synthetic fibers. This total was $569 million in 1955, a more realistic figure that excludes such factors as processing costs, natural raw materials and profits that are part of the final synthetic fiber price paid at the mill.

The impact of synthetic fibers on the chemical industry is clearly seen in Figure 4. If we continue to think of textile fibers as a chemical commodity, and a total chemical use by the textile industry of $2.3 billion, as shown in Figure 2, we find that $1.9 billion or 83 percent of this total represents synthetic-fiber consumption. The remaining 17 percent is divided between dyes and finishes ($175 million) and textile processing chemicals ($211 million).

As a matter of interest, let us see how each of these categories is divided between chemicals from petrochemical and nonpetrochemical sources (Figure 5.). Petrochemicals supplied 30 percent of the synthetic fiber usage, 50 percent of the dyes and finishes and 26 percent of the requirement for textile processing chemicals.

There is a remarkable number of chemical products consumed in the processing of textiles that do not appear in the final textile product. Let us look in somewhat more detail at the specific textile processing chemicals and the extent of their use. $156 million worth of nonpetrochemical products were used for textile processing in 1955. Figure 6 shows the major products falling in this category—starches, soaps and some of the synthetic detergents, bleaches, caustic, lubricants and salts. These are the workhorses of the business—the classic textile processing chemicals. The miscellaneous category includes aromatics, chlorinated hydrocarbons, miscellaneous acids and salts, glycerol, and numerous other nonpetrochemical materials.

In 1955, $55 million worth of petrochemicals were also used for textile processing. Figure 7 shows the major products used. Synthetic detergents dominate the picture, but the other categories represent growing uses. Here the miscellaneous classification includes such materials as formaldehyde, synthetic glycerol, miscellaneous solvents, and defoamers as well as a host of so-called "textile specialties."

Because the petrochemical portion of the textile processing chemicals market was small in 1955 we should not infer that the stake of the petrochemical industry in textiles is negligible. To verify this point, look at the growth rate of the largest petrochemical use area in the textile industry—synthetic fibers. While personal expenditures for clothing are showing a growth rate of 2.5 percent per year, petrochemical fiber intermediates are growing 15 percent per year and during the last five years have grown at a considerably higher rate (Figure 8). This penetration of petrochemicals into the venerable and established textile industry is

Figure 5

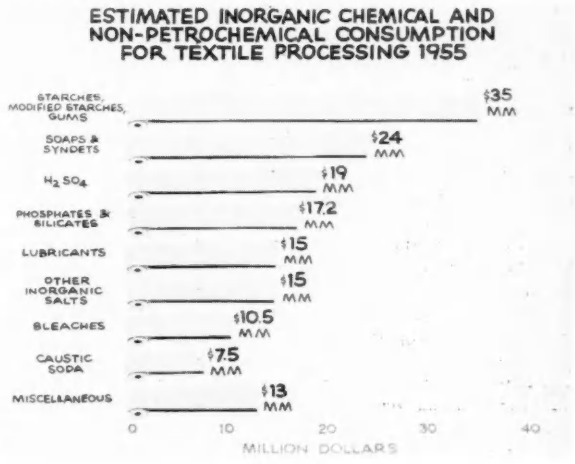

ESTIMATED INORGANIC CHEMICAL AND NON-PETROCHEMICAL CONSUMPTION FOR TEXTILE PROCESSING 1955
STARCHES, MODIFIED STARCHES, GUMS $35 MM
SOAPS & SYNDETS $24 MM
H2SO4 $19 MM
PHOSPHATES & SILICATES $17.2 MM
LUBRICANTS $15 MM
OTHER INORGANIC SALTS $15 MM
BLEACHES $10.5 MM
CAUSTIC SODA $7.5 MM
MISCELLANEOUS $13 MM
0 10 20 30 40
MILLION DOLLARS

Figure 6

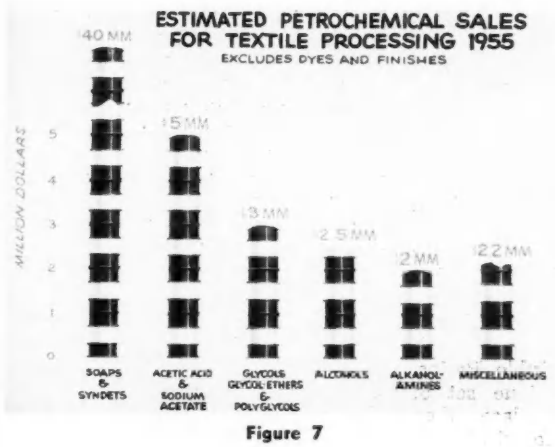


Figure 7

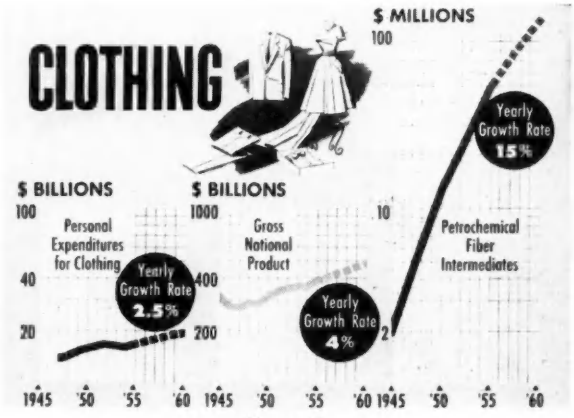


Figure 8

truly remarkable. Indeed, this development is symptomatic of a major trend that is becoming increasingly important in the operations of the textile industry.

The constant flow of research and development ideas from both textile and chemical laboratories has begun to work a revolution in textile processing. The new synthetic fibers, for example, created by chemical synthesis, have made possible great advances in textile technology. They have at the same time created many new problems in processing and finishing. This mixed blessing poses a constant challenge to management and research groups alike in both the textile and the chemical industries. It also offers to the chemical industry a major opportunity for the development of new and useful textile processing chemicals. Let us now explore for a few moments some of the more recent chemical developments that have been generated by the needs of the textile industry.

RECENT CHEMICAL DEVELOPMENTS GENERATED BY THE TEXTILE INDUSTRY——Synthetic fibers have brought dyeing problems to the dyehouse that have no precedent in the dyeing of natural fibers. New dyestuffs and new dyeing techniques have had to be developed. Blends of synthetic and natural fibers have also shown great promise in the textile market, since they combine the outstanding properties of both fiber types and provide improvement in durability, comfort and appearance. This development has complicated the dyeing problem even further.

Rising to the challenge, textile and dye chemists have developed solvent dyeing techniques that make possible even dyeing of synthetics and blends in a variety of hues and colors. The immediate result of this development is the growth of markets for new types of dyestuffs and also for petrochemicals, such as glycols, glycol-ethers and similar solvents, as well as other dyeing assistants, such as amines. For example, approximately $3/4 million worth of glycol-ether type solvents were sold to the textile industry in 1955 for solvent dyeing. This process, which was negligible only a few years ago, appears to have grown substantially during 1956, and because of continuing interest and development by the textile industry, seems destined to continue to grow.

Static in textiles is a second problem which has been made much more acute by the growth of synthetic fibers. Treatment of both natural and synthetic fibers with temporary antistatic agents to improve mill processing and reduce fly has long been common practice, but the growing use of synthetics and blends in apparel and carpeting has now taken the static problem out of the mill and into the consumer's home. The temporary antistatic finishes, such as oils, soaps, glycols, polyglycols and nonionic surfactants used as processing aids are not adequate for the control

of static generation in finished textile articles. Discomfort, poor appearance, lint pick up, pilling and increased rate of soil are all symptoms of the static charge carried by synthetic fibers. These problems have resulted in a growing demand for an easily applied, colorless antistatic finish durable to washing and drycleaning and nondeleterious to hand, for general use on synthetic fiber textiles and blends. A few products have made their appearance on the market, but to date, all appear to have serious limitations. Nevertheless, each new product offers some improvement over its predecessors in properties or performance. There is little doubt that in time the chemical industry will develop antistatic finishes that will substantially eliminate the static problem on synthetics.

Fiber lubricants, based on petrochemical products, are additional examples of new textile processing chemicals. These materials make possible controlled variation of lubricant properties so that the desired fiber processing characteristics can be obtained. In addition, because these new lubricants are water soluble, they are easily removed and minimize dyeing problems. Synthetic machinery lubricants that are nonstaining and easily removed can also be formulated.

As one more example of the growth of new chemical uses in the textile industry, let us discuss one of the major textile processing chemicals of natural origin — starch. Starch has many virtues. It is low in cost, it is readily available in plentiful quantities and it is an effective warp size for cotton. Above all, perhaps, its performance characteristics are well known to textile operators from long years of experience. It is an old friend. Consider, however, the shortcomings of starch. It is variable in properties. It does not age well. Its solutions must be carefully prepared and quickly used, or else discarded. It must be removed from woven goods by enzymatic degradation. It is inadequate as a warp size for many synthetic yarns. In recent years, one of the major problems facing textile mill operators has been that of stream pollution, and here starch may be facing the most serious threat to its supremacy as a textile processing chemical, for a major portion of the stream pollution load from a textile mill originates in the sizing operation. This is primarily because of the high biological oxygen demand of starch itself.

Many approaches have been made to the problem of developing an adequate and economical replacement for starch. Modified starches, with improved solution properties, better batch consistency and greater solution stability, have been developed. They are gaining wide acceptance in the textile industry, and represent an excellent case of product development in the textile processing field. One of their remaining and serious shortcomings is that they do not sufficiently reduce the critical stream pollution problem. Carboxymethyl cellulose is being used and widely evaluated in textile processing operations as a replacement or partial replacement for starch, and polyvinyl alcohol is also being used in certain sizing applications where its properties are advantageous.

Union Carbide's research laboratories have been absorbed for several years with the problem of manufacturing water-soluble resins of very high molecular weight. The growing need for an improved textile warp size has been one of the main factors accelerating the development of these materials. As a result of this prolonged research effort, there is now available in development quantities a series of high-molecular-weight polyethylene oxide polymers which show great promise for textile warp sizing and in a number of other textile applications. These polymers, which will be marketed under the trademark name Polyox Water-soluble Resins, seem to combine a unique set of properties. In the first place, they exhibit essentially no biological oxygen demand, and in these days of increasingly stringent regulation of stream pollution, this factor is of immediate interest. Polyox resins are, in addition, tough, extensible, thermoplastic materials which are excellent film formers, and which are completely water soluble. They are made from ethylene oxide, which is a relatively low-cost raw material available in large quantity. They are available as white granular products which can be handled in conventionl mill equipment under normal mill conditions.

When used as a cotton warp size, Polyox resin may be readily dissolved in water at room temperature. It is the only material that needs to be added to the size bath, and requires no additives. The resin itself forms a tough, flexible film on the warp fibers, and it retains its water solubility after slashing and drying so that removal from the woven fabric may be carried out with a simple scour.

Experimental evaluation of the warp sizing performance of Polyox resin on cotton warps has been carried out in extensive laboratory scale studies and also in a significant number of trials in textile mills on standard mill equipment. In mill operations, slashing has been done on a two-can cotton slasher and on a multiple-can slasher. The size boxes contained one immersion roll and two sets of squeeze rolls. In a normal mill run, squeeze-roll pressure is adjusted to give a 110-130 percent wet pickup. Size concentration is 3.75 percent, providing a dry size add-on of 4.5 percent. Drying of the warp is extremely important, as excess moisture in the size film will tend to cause the resin to swell, and the warps may cling to the beam.

Weaving of Polyox-sized cotton warps has been done on both Draper XD and regular cam type looms, at speeds of 168 to 185 picks per minute. Warps of 40's combed yarn and 30's carded yarns have been used. The fabrics woven have been essentially 80 x 80 print cloth. Weaving has been carried out under varying conditions of relative humidity, ranging from 40 to 90 percent, with very satisfactory weaving performance. Because of the water solubility of the size, it is necessary to avoid the spraying of water droplets on the sized warp. Liquid water will cause the normally dry film to become tacky, and the formation of fuzz balls and matted ends along the warp will result, with a consequent loss of weaving efficiency.

Fabrics woven from Polyox-sized warps have a pleasant, soft, full hand as they come from the loom. Removal of the size requires no enzyme or other degradation assistants, and the desizing operation does not add to the BOD of the mill effluent.

Much work remains to be done in both the chemical and the textile laboratory before these interesting new resins are fully adapted to routine textile mill use as warp sizing materials. They behave very differently from starch in all phases of the sizing operation, and this will cause many problems in their satisfactory performance in the mill. Nevertheless, a significant start has been made on the development of a new textile processing chemical that could substantially reduce the stream pollution problem of the textile industry, and conceivably could bring about conditions of physical comfort in the weave room of the cotton mill. Preliminary studies also indicate that materials of this type may offer a solution to the warp sizing of such difficult yarns

(Concluded on page P190)

36th Annual Convention———

THE DYEING OF FILAMENT NYLON WITH ACID DYES*

J A BITTLES, J A BROOKS, J J IANNARONE JR and H P LANDERL

E I duPont de Nemours & Co, Inc
Wilmington, Del

Four aqueous level-dyeing procedures for applying acid dyes to filament nylon are discussed. These are solvent-assisted dyeing, cationic agent-assisted dyeing, anionic agent-assisted dyeing, and high-temperature dyeing.

Solvent-assisted dyeing is of little commercial importance except in special cases because of the expense and/or hazards involved.

The newest technique for dyeing nylon levelly wth acid dyes involves the addition of a cationic-active agent to the dyebath. With this procedure, dyeings with excellent levelness can be obtained at temperatures below the boil if carefully selected dyes are used. The older anionic-agent-assisted bath is less effective in covering streaks at temperatures below the boil.

At temperatures above the boil (235-250°F) both the anionic- and cationic-assisted systems produce good levelness. However, under these conditions the anionic procedure is somewhat better because of the increased amount of transfer obtained.

All of these procedures have their limitations because only selected dyes can be used. These dyes are not necessarily those which give the best fastness, but they are significantly better than disperse dyes. In most cases the wetfastness is excellent if a suitable aftertreatment is used.

INTRODUCTION

TODAY, the dyer is faced with increasing coloration trends toward medium and deep shades in washable nylon-filament-yarn fabrics. This is resulting in new, high standards for washfastness. Disperse dyes, which have such great utility on nylon because of their excellent leveling characteristics, cannot meet these washfastness requirements. Anionic dyes which dye by a strong ionic bonding mechanism give the requisite fastness; however, they have not been widely used because of their poor leveling characteristics which lead to unacceptable streaky fabrics. The purpose of this paper is to review the level-dyeing methods, comparing their merits and shortcomings and to review the importance of dye selection in these dyeing procedures.

Streaks in acid-dyed nylon fabrics have long been of concern to both the yarn producer and to the dyer. The streak problem in dyed nylon fabrics can be broken down into two categories:

1) Dye streaks in which different amounts of color are absorbed by neighboring yarn bundles;
2) Configurational or physical streaks in which the yarn bundles may absorb equivalent amounts of dye but appear streaked because of different degrees of reflection.

Dye streaks are the most significant problem in tricot knit fabrics. These streaks can sometimes be attributed to irregularities inherent in the starting yarn. Disperse dyes are not as sensitive to these irregularities and thus strike more evenly on the fabric. These dyes also have the ability to transfer or migrate. This property contributes to their superior level-dyeing properties, but at the same time, contributes to their low order of washfastness. Many anionic dyes, on the other hand, are extremely sensitive to irregularities in the yarn bundles and emphasize the yarn nonuniformities. Most of the problems can be traced to differences in the fine fiber structure. This results in different diffusion rates and not necessarily in differences in equilibrium dye uptake. These differences in permeability have the effect of making some dye sites more difficult to reach than others. Thus, the acid dyes are prone to strike unlevelly and, because of their strong bonding characteristics, there is little opportunity for leveling of the nonuniformities by transfer.

There has been significant progress in producing yarns of greater inherent uniformity. This progress plus advances in the past three years in acid dye selection and in dye application methods now make it possible for the dyer to achieve levelness approaching that of disperse dyes while meeting the higher standards for washfastness.

The dyeing procedures to be covered in the discussion below are: solvent - assisted dyeing, cationic agent-assisted dyeing, anionic agent-assisted dyeing, and high-temperature dyeing.

SOLVENT-ASSISTED DYEING

The use of solvents in dyeing nylon has not been accepted commercially because of the inherent problems for which there are no ready solutions. These problems are:

1) High cost—rather high concentrations (2 - 3% on a solution basis) are generally required.
2) Volatility — most solvents are sufficiently volatile to be a nuisance even if not toxic or flammable.
3) Toxicity—some of the vapors are toxic and/or the solutions corrosive.
4) Disposal—many of the agents are undesirable in disposal systems.

However, some solvents are especially effective in overcoming streaks. In fact, the solvent-assisted dyeing procedure is the only dyeing method known for diminishing the configurational or physical streaks which were mentioned earlier.

PHENOL DYEING (CHENEY PROCESS)———This process was purchased by Du Pont and offered to the trade*(1)*. It consists of applying acid dyes at 212°F in a closed, ventilated jig in the presence of a 3.0% solution of phenol buffered with a 2.0% solution of sodium acetate. Gradual exhaustion of color is obtained with acetic acid or formic acid. In woven fabrics, where configurational streaks are encountered, this process offers a marked improvement in fabric uniformity. Dye streaks are also masked. In the phenol dyebath, alkyl alcohol sulfates, such as Duponol D Paste surface-active agent, are of added benefit in a true dye streak problem.

OTHER SOLVENTS———Selection of a commercially acceptable solvent or swelling agent, which will overcome the differences in yarn order that contribute to streaks, is difficult. Investigation in this area revealed benzyl alcohol as a likely candidate, except for its cost. Rather remarkable improvements in acid dye levelness can be obtained with this

* Presented by H P Landerl on November 16, 1957 at the 36th Annual AATCC Convention at the Hotel Statler, Boston, Mass.

agent when combined with anionic leveling agents. To obtain maximum benefit, a 3% solution of solvent is required. Removal of residual solvent in the goods is necessary and is effectively accomplished after dyeing by a heat treatment at 400°F for 20-30 seconds.

CATIONIC AGENT-ASSISTED DYEING

The most recently developed level-dyeing process for applying acid dyes to filament nylon is a cationic agent-assisted procedure. The use of cationic-active dyeing assistants for nylon is not new *(2)*; however, their use in obtaining level dyeings with acid and direct dyes were first reported by The Chemstrand Corporation *(3)*. There undoubtedly are several variations on this process, but in general the dyeing procedure consists of adding a cationinc agent and a nonionic agent to the bath containing selected acid or direct dyes and carrying out the dyeing at a relatively low pH, 3 to 3.5. If carefully selected dyes are used and the fabric is of such a uniformity that it can be dyed levelly with disperse dyes, good levelness can be obtained.

DYEING PROCEDURE——One commercial dyeing procedure recommended by Du Pont is outlined below for beam or reel dyeing of tricot.

Scour at 180°F with
1.0% nonionic detergent
1.0% polyphosphate.
Set dyebath at 120°F with
4-5% Alkanol LN surface-active agent (a product combining cationic and nonionic properties).
Run for 5 minutes and add
formic acid to give a pH of 3 to 3.5.
Run 10 minutes and add recommended dyes.

The bath temperature is raised to 200-212°F (the highest temperature attainable should be used) and dyeing continued for 1½ hours. Additions of dye can be made at the maximum dyeing temperature, even at the low pH, without the rapid strike normally expected under these conditions. The pH of the bath should be checked occasionally to be certain that it does not creep above 3.5.

In jig dyeing the bath should be set at 180°F with 2-3% Alkanol LN surface-active agent and formic acid to a pH of 3 to 3.5.
Run 2 ends at 180°F.
Add dye.

The normal acid dye strike is not encountered with the cationic process until the dyebath and fabric approach 212°F. Better control of dyeing rate is obtained if the temperature is raised to the boil and run for several ends before closing the jig cover and dyeing in the usual steam atmosphere.

DYE SELECTION——The most important single factor is the selection of dyes to be used with a specific cationic agent. Over eighty dyes have been tested in a typical cationic-agent process on a fabric made from specially prepared yarns which contain gross nonuniformities. The dyes which offered good coverage of the nonuniformities are listed in Table I.

TABLE I

Dyes recommended by Du Pont for use in the cationic agent-assisted dyeing process with Alkanol LN Surface-Active Agent

	New CI	*Old CI or Pr*
Acid Yellow 40*	18,950	642
Acid Yellow 34	18,890	636
Acid Yellow 11	18,820	636
Acid Yellow 17	18,965	639
Direct Yellow 44	29,000	Pr 53
Cibalan Yellow 3GL	—	—
Nylanthrene Yellow FLW	—	—
Acid Orange 7	15,510	151
Mordant Orange 6	26,520	274
Nylanthrene Orange SLF*	—	—
Acid Red 66	26,905	280
Acid Red 73	27,290	252
Direct Red 39	23,630	382
Direct Red 37	22,240	382
Acid Red 80	68,215	1,091
Acid Red 1	18,050	31
Acid Red 4	14,710	114
Pontacyl Scarlet NN*	—	—
Benzyl Fast Red 2BL*	—	—
Xylene Fast Red P	—	—
Acid Blue 45	63,010	1,054
Acid Blue 47	62,085	1,076
Acid Blue 78	62,105	1,088
Acid Blue 25	62,055	Pr 12
Celanthrene Fast Blue GSS*	—	—
Du Pont Anthraquinone Blue 2GA	—	—
Du Pont Anthraquinone Blue RA	—	—
Supernylite Blue B	—	—
Acid Violet 43	60,730	1,073

* Especially level dyeing and compatible in critical shades.

The recommended group of dyes is sufficient to allow formulation of most any shade. To obtain the maximum utility of the process and to meet specific requirements for brightness and lightfastness it is sometimes necessary to choose specific combinations of dyes from the recommended list. The dyes marked with an asterisk have been found to work well together and are especially recommended in making critical shades such as grays and tans on fabrics which are usually difficult to level.

FASTNESS PROPERTIES——The most important improvement in fastness properties obtained by the use of acid dyes in place of disperse dyes is in washing. However, the fastness to washing of the several types of acid dyes varies considerably.

It can be seen from Table II that some of the preferred dyes that offer the best masking of yarn irregularities do not show the ultimate in acid dye washfastness. The washfastness of shades produced with these dyes is considerably superior to that of disperse dyes. When the ultimate in acid dye washfastness is demanded, aftertreating is very effective in producing such fastness. The preferred aftertreatment is with tannic acid-tartar emetic combined with a chelating agent, such as Versene, to minimize alteration of shade. This aftertreating method is a normal practice for most acid dye shades requiring AATCC #3 fastness (160°F) *(4)*.

TABLE II

Fastness to washing of dyes on nylon tricot (medium depth shades)

Dye Class	*AATCC Wash Test #1 105°F*	*#2 120°F*	*#3 160°F*
Milling acid	5	5	4
Level-dyeing acid dyes (Table I)	5	4	2
Level-dyeing acid dyes (aftertreated*)	5	5	4
Disperse dyes	4-3	2	1

*Tannic acid-tartar emetic
Rating Scale:
5=No shade change or staining
3=Moderate shade change and staining
1=Severe shade change and staining

The dyes on the recommended list will produce shades having lightfastness typical of the true acid dyes. However, the shades produced cannot be expected to approach the ultimate lightfastness offered by neutral-dyeing premetalized acid type dyes.

MECHANISM OF LEVELING ACTION——The overall effect of the cationic agent is a reduction in the rate of dyeing. This can be seen in Figure 1 where the rate of exhaustion of a dye in the presence of a cationic retarder is compared with that obtained in the absence of such an agent. However, this is only the gross effect and does not explain how leveling from yarn to yarn is effected.

The cationic leveling agent and the anionic acid dye combine in the dyebath to form a complex which has limited solubility and must be kept dispersed with a nonionic dispersant. This complex has been described as having properties similar to a disperse dye *(3)* so that dyeing of the nylon is effected through the same mechanism as that which has been ascribed to disperse dyes, namely solution in the fiber. If this is true, the complex should dye acetylated nylon, which contains essentially no free amine end group dye sites, as readily as unacetylated nylon. In Figure 2, dyeings made on acetylated nylon with a disperse dye and an acid dye complexed with Alkanol LN are shown. The complex does not dye at all under the neutral pH conditions normally used to apply disperse dyes. If, however, the relatively

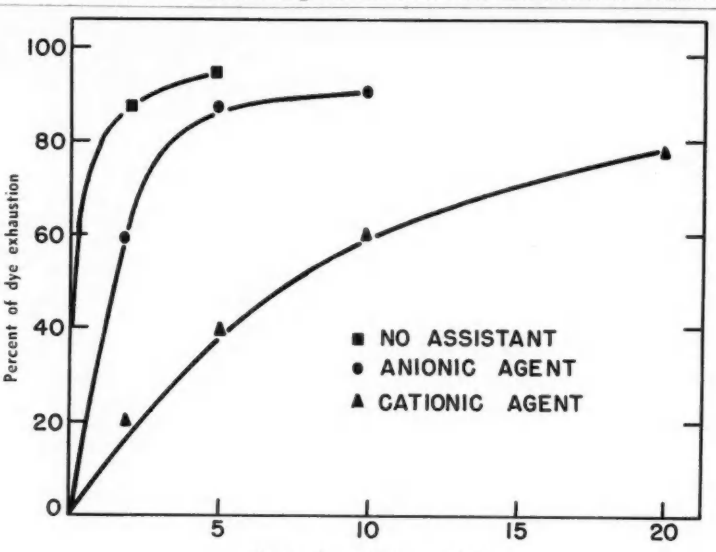
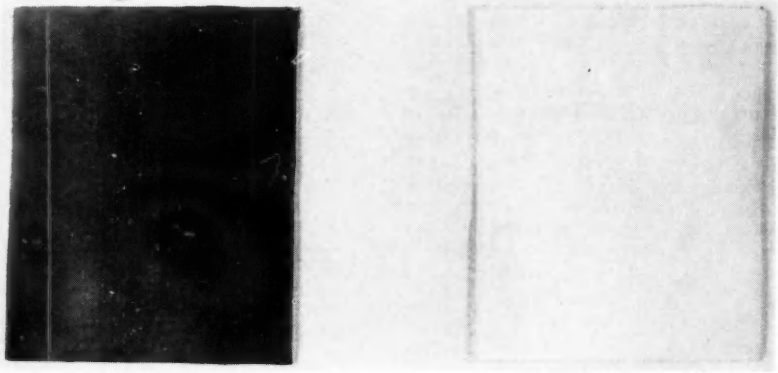


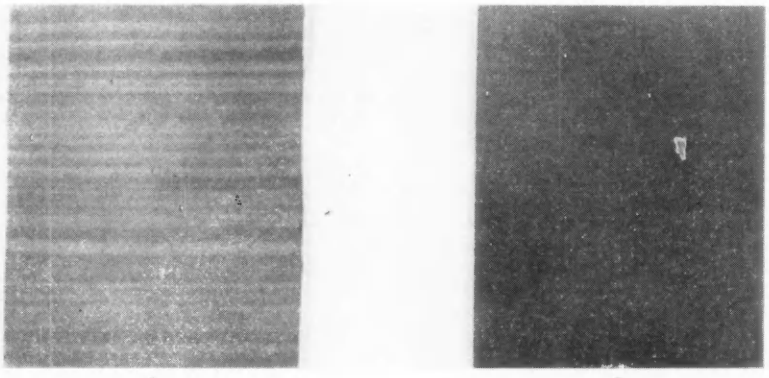
Figure 1
Rate of exhaustion of 0.5% Benzyl Fast Red 2BL on nylon tricot



Disperse dye

Pontacyl Carmine 2G & Alkanol LN applied as a disperse dye

Figure 2
Acetylated nylon



A
All dye added at the beginning of the dyeing pH 3

B
Dyed from colorless bath pH 3

Figure 3
Effect of dye concentration on streak coverage—0.5% Pontacyl Carmine 2G

strong acid conditions (pH 3), recommended for the cationic agent procedure are used at 250°F, the fiber is colored to a limited degree. Similar results are obtained if the cationic agent is omitted. These results can be explained by hydrolysis of the amide linkages, under the acid conditions, to regenerate some of the free amine dye sites *(5)* or by dyeing of the amide groups *(6)*. Thus the disperse dye mechanism does not appear to be operating in the cationic agent process.

Transfer can be an effective leveling factor in the cationic-agent dyeing process. In the case of Pontacyl Scarlet NN, a typical dye which levels well when applied by this process, the cationic agent does increase the transfer over what is obtained in its absence under the low pH conditions, but the transfer is not as good as that obtained in the absence of the cationic agent under neutral conditions. Yet the cationic-agent process, where less transfer occurs, gives more level results than can be obtained from a neutral unassisted bath which permits a greater amount of transfer.

A more likely explanation may lie in the work of McGrew and Sharkey *(7)*. It was stated earlier that the differences in fine fiber structure result in differences in dye-site accessability. Two fibers having the same number of amine end groups but in which the rate of diffusion is different will dye to different strengths in a bath containing insufficient dye to saturate all the sites. When such fibers are dyed from a bath in which all of the dye is introduced at one time, unlevelness will result because the dye molecules seek out the readily available dye sites. If, however, the dyeing is carried out in a bath from which the dye will exhaust very rapidly (pH 3), but which contains only a trace of dye at any one time, the dye molecules do not recognize differences between the fibers and a statistical distribution of the dye is obtained.

This principle has been demonstrated by dyeing nylon tricot with Pontacyl Carmine 2G in a bath containing no dyeing assistants at a pH of 3. When all of the dye was added at one time, the streaky dyeing shown in Figure 3A was obtained. By adding the dye very slowly, so that the bath was always essentially colorless, the level dyeing shown in Figure 3B was obtained.

This may be one of the mechanisms by which the use of cationic-agent process produces level dyeings since one of the effects of the complex

formation of the dye and cationic agent is to reduce the amount of free dye in the bath. An equilibrium is set up between the dye-cationic agent complex and the unassociated dye and unassociated cationic agent:

$$[\text{Dye-cationic agent}] \rightleftarrows [\text{Dye}]^- + [\text{cationic agent}]^+$$

The complex, as indicated earlier, cannot dye the fiber. Only the unassociated (or dissociated) dye on the right side of the equation is available for dyeing. Under the conditions recommended for the cationic process (low pH), the free dye will rapidly exhaust onto the fiber. Dissociation of the complex liberates more dye, which then can dye the fiber, and the process continues until most of the color has left the bath. The fact that Figure 1 showed the overall rate of these dyeings to be slow, even though carried out under conditions which would lead to rapid exhaustion of free dye, is further evidence consistent with this mechanism. The rate of exhaustion of color from the bath is determined by the rate of dissociations of the complex. Some dyes are almost completely reserved by this process because either the degree or rate of dissociation of the complex is too slow. Only dyes which form complexes which have the proper degree and rate of dissociation will be operable by this process. This mechanism is further supported by the fact that only dyes which, in the absence of cationic agent, will exhaust very rapidly at pH 3 show marked improvement in levelness when used in the cationic agent process.

ANIONIC AGENT-ASSISTED DYEING

The anionic agent-assisted dyeing method for applying acid dyes to filament nylon was developed several years ago *(8,9)*. This process consists of dyeing from a bath containing an anionic agent, such as Duponol D Paste surface-active agent. Once again with *selected* dyes, it is effective in materially increasing the levelness of acid dyes on nylon fabrics which will dye levelly with disperse dyes.

PROCEDURE———There are several minor variations of this process but a typical procedure consists of setting a bath with

2-3% Duponol D Paste surface-active agent
10% ammonium sulfate*
x% selected acid dyes

*In place of ammonium sulfate, other acid forming salts or acetic acid (pH 5) can be used.

It is sometimes necessary to add an antifoaming agent to control foaming. The temperature is raised to the boil and acetic acid added as necessary to exhaust the dye. In making pale shades on a fabric which is particularly difficult to dye levelly, a pretreatment with 5.0% Duponol D Paste and 2.5% acetic acid at the boil has given excellent results.

This process has a disadvantage not encountered in the cationic-agent process. The anionic agent occupies dye sites and can limit the depth of shades which can be obtained.

DYE SELECTION———The dyes recommended for the cationic-agent process (Table I) also give the best results in the anionic-agent process. In addition

	New CI	*Old CI*
Du Pont Milling Red SWB	—	430
Acid Green 25	61,570	1,078

have been used successfully for bright green and red shades. Many other dyes show improved levelness by this process, but the recommended dyes have been found to give the best results.

FASTNESS———The fastness of dyeings made by the anionic agent process and by the cationic agent process are identical and neither agent has been found to increase nor decrease the fastness of any dyeing.

MECHANISM ——— The mechanism by which the leveling takes place is quite different from that which operates in the case of a cationic leveling agent. The Duponol D Paste is for all practical purposes a colorless acid dye which competes with the dye for the dye sites. It is speculated that the Duponol D Paste occupies the more readily available sites forcing the dye to seek out the less available sites which seem to be more equally available from fiber to fiber. Since the Duponol D Paste does occupy dye sites, it does limit the depth of shade which can be obtained.

The rate of exhaustion for a dye in the presence of Duponol D Paste, shown in Figure 1, is only slightly slower than when no dyeing assistant is used. This will change considerably from dye to dye and with changes in dye and leveling agent concentrations. The levelness of the dyeings represented by the curves in Figure 1 is not necessarily consistent with the curves. The two leveling agents give almost equivalent leveling while the unassisted dyeing is considerably less level.

COMPARISON WITH THE CATIONIC AGENT-ASSISTED PROCESS———The anionic agent procedure has one very practical advantage in this highly competitive field, that is, a significantly lower cost than the materials used in the cationic-agent process. However, from the performance standpoint on nylon tricot at temperatures below the boil, the cationic-agent process appears to have the following advantages over the anionic agent dyeing procedure:

1) *Improved Streak Coverage.* A comparison of the streak coverage for a range of shades applied by the two processes is found in Table III. Both processes are also compared with disperse dyes. It can be seen that the cationic agent process at 212° F produces dyeings somewhat more level than the anionic-agent process. At the boil, both processes will produce commercially acceptable dyeings, but both are also slightly inferior to disperse dyes for levelness. At temperatures below 212°F, the advantages of the cationic agent-assisted process is still greater.

TABLE III
Relative effectiveness of level dyeing methods and disperse dyes in covering tricot barré (Dyeing at 212°F)

Type of dyes	*Dyeing assistant*	*Streak coverage**
acid	none	4
acid	Duponol D Paste (anionic)	7
acid	Alkanol LN (cationic)	8
disperse	none	9

*average rating for a typical range of colors
Rating Scale:
10=perfect uniformity
7=borderline of commercial acceptability
1=severe streakiness

2) *Improved handle of fabric.* The cationic agents have a softening effect on the fabric which remains after finishing. This softening is desirable, particularly for tricot.

3) *No limitation to depth of shade.* The anionic agents reduce the number of available dye sites which makes it necessary to balance the amount of leveling agent and dye so that excessive reserving is not obtained. The amount of leveling agent required in the cationic agent process is the same for all shades.

HIGH-TEMPERATURE DYEING

Many of the nonuniformities which are only partially covered when dyeing at 212°F, or below, can be completely covered if the dyeing temperature is raised to 235-250°F*(4)*. The best coverage of streaks on the largest

(*Concluded on page P194*)

Research Committee Report———

LAUNDERING PROCEDURES IN THE COMMERCIAL LAUNDRY AND IN THE HOME

COMMITTEE ON DIMENSIONAL CHANGES IN TEXTILE FABRICS

J F WARNER, *chairman*
D B Fuller Co
EDWARD ARTIM, *secretary*
J C Penney Co, Inc

Steering Committee

H R BELLINSON
Cluett, Peabody & Co, Inc
H C DONALDSON JR
Cluett, Peabody & Co, Inc
ALBERT E JOHNSON
National Inst of Drycleaning
LEONARD LOEB
Home Laundry Div
General Electric Co
GENEVIEVE SMITH
Sears, Roebuck & Co
RALPH D SMITH
N J Laundry & Cleaning Inst
JOHN G STASS
Quality Control Dept
Burlington Mills Corp
GEORGE S WHAM JR
Good Housekeeping Inst
CAMERON A BAKER
U S Testing Co
F A MURPHY
Stevensons

The main objective of the Committee on Dimensional Changes in Textile Fabrics is to develop shrinkage tests by which it will be possible to predict the dimensional stability of fabrics under normal conditions of washing. The Committee felt that, before developing such tests, it should first determine the methods by which fabrics are laundered under service conditions both in home and commercial laundries, and this paper represents the results of its survey. In the paper's preparation, the Committee has had the helpful cooperation of home laundry equipment manufacturers as well as commercial laundries.

J F Warner, chairman

I. INTRODUCTION

ONE of the most important characteristics of a textile article is the manner in which it behaves when subjected to the laundering process. The general term, "washability," includes many important factors, primary among which are colorfastness, dimensional stability and durability of finish.

There exist already adequate test methods for determining the colorfastness of fabrics to laundering. In the area of shrinkage-test procedures, however, the commonly used shrinkage test at high temperatures is very satisfactory for many fabrics but is unsatisfactory for others. AATCC Tentative Test Method 40-1957 has been shown recently to give shrinkage results equivalent to hand washing. However, between these two limits there currently is no existent adequate method for predicting the shrinkage characteristics of many commonly used fabrics. The need for such test methods was recognized by the Committee on Dimensional Stability of Textile Fabrics of the AATCC. Work has been initiated to develop procedures which would give an accurate and reproducible measurement of the dimensional stability of fabrics of intermediate degrees of washability.

In developing such tests, it was felt necessary first to determine methods by which fabrics are laundered under serviceability conditions both in the home and in commercial laundries. To gather this information, a survey was made of the various techniques of laundering. This survey revealed that, both in the commercial laundry and in the home, there existed rather definite gradations in the washing process, which are based on the degree of colorfastness, fiber content and garment construction. These factors must all be considered in determining how an article is to be washed and ironed.

In a discussion of washing procedures, it is possible only to present average processing conditions for any particular level of washability. It should be pointed out that, both in the home and in the commercial laundry, there will be deviations from the average, depending upon the operating conditions and the equipment employed. Although cognizant of this fact, the Shrinkage Committee felt that these deviations would have no discernible effects on the dimensional change of the fabrics laundered according to the various techniques discussed below.

NOTE: This paper is not intended to present the procedures outlined as optimum laundering conditions. On the contrary, the conditions listed represent more nearly the manner in which textile end-use items are handled in good commercial laundries and in the home.

II. WASHING PROCEDURES OF COMMERCIAL LAUNDRIES

PROCEDURE #1—WHITE WORK WASHING———This type washing formula is used for cotton, linen and many other fibers with the exception of silk, wool or other protein fibers. Fabrics so processed are often more or less heavily soiled or stained in normal use. This washing formula may also be used for colored fabrics which are suitably dyed and whose use conditions make is desirable. A typical washing formula for a 100-pound load is shown in Table I.

The amount of water added on the first suds includes that necessary to saturate the load. This is approximately 0.3 gal per pound of dry fabric.

TABLE I
White work washing

No. of bath	*Kind of bath*	*Temp (°F)*	*Water (inches)*	*Water added (gal)*	*Time (min)*	*Amount and kind of supplies*
1	suds	100–120	6–8	51–58	7–10	6–10 oz soap—high titer 8–16 oz alkali
2	suds	120–140	5–7	21–26	7–10	2–4 oz soap
3	suds	130–150	5–7	21–26	7–10	1–2 oz soap
4	suds & bleach	140–160	5–7	21–26	7–10	no soap or alkali, not more than two quarts of 1% available chlorine bleach per 100 lbs of dry fabrics.
5	rinse	160	12	39	5	
6	rinse	160	12	39	5	
7	rinse	160	12	39	5	
8	rinse	140	12	39	5	
9	sour	120	5	21	5	sour to pH 5.0*
10	blue	90–100	10	33	5	blue as required

*Sours, which are weak acids, are commonly used in the various laundry washing formulas to neutrlaize residual alkali which it is not practical to remove by rinsing or which exists in the tap water used for washing and rinsing. It is desirable to neutralize this alkali to prevent yellowing of the fabric during the finishing operations.

The total water present in the wash wheel on each of the sudsing operations varies between 0.5 and 0.6 gallons per pound and on the rinses, is approximately 0.7 gallons per pound.

The soap used on white work loads usually has a tallow base and a titer close to 42° C.

The alkali used in white work formulas is usually of a type which will give pH of 11.0 to 11.6 on the suds baths when used in the quantities indicated. Sodium sesqui and ortho silicate are typical of this class of alkalies.

PROCEDURE #2—FAST COLORS———This group includes those colored fabrics except silk and wool which often become more or less heavily soiled during use, but which cannot be bleached without undue loss of color. A typical washing formula for 100-pound load is shown in Table II.

The soap used in the case of Procedures 2 and 3 usually has a titer 20°-30° C. The soap and alkali are often added in the form of a built soap, which frequently has a soap-alkali ratio of two soap and one alkali, and additional alkali may or may not be used on the first suds. Recently there has been a growing tendency to substitute built synthetics for the corresponding soap products. Colored work on the average contains more soil than white work and the soap consumption will therefore be higher.

The alkalies used for colored work washing are usually in the medium-to-high buffer range and the suds baths under such conditions will have a pH of 10.3 to 10.6 for fast colors and 10.0 to 10.4 for colors of moderate fastness. Alkalies, such as modified soda, soda ash, trisodiumphosphate and sodium meta silicate, are commonly used.

PROCEDURE #3—COLORS OF MODERATE FASTNESS———This method of washing is suitable for all launderable fabrics not included in the above two classifications with the exception of wool, and items that require special handling because of fiber content or garment construction. A typical washing formula for 100-pound load is shown in Table III.

PROCEDURE #4—WOOL WASH———This method of washing is suitable for wool and delicate fabrics. A typical formula for 100-pound load is shown in Table IV.

The wheel used is run at low speeds and is designed to give low mechanical action, so as to prevent felting.

TABLE II
Fast colors

No. of bath	Kind of bath	Temp (°F)	Water (inches)	Water added (gal)	Time (min)	Amount and kind of supplies
1	suds	100–110	6–8	51–58	7–10	8–14 oz soap—low or medium titer 8–10 oz alkali
2	suds	110–120	5–7	21–26	7–10	2–4 oz soap
3	suds	120	5–7	21–26	7–10	1–2 oz soap
4	rinse	120	12	39	5	
5	rinse	120	12	39	5	
6	rinse	120	12	39	5	
7	rinse	120	12	39	5	
8	sour	90–100	5	21	5	sour to pH 5.0

TABLE III
Colors of moderate fastness

No. of bath	Kind of bath	Temp (°F)	Water (inches)	Water added (gal)	Time (min)	Amount and kind of supplies
1	suds	90–100	6–8	51–58	7–10	8–14 oz soap—low to medium titer 3–5 oz alkali
2	suds	90–100	5–7	21–26	7–10	2–4 oz soap, 1–2 oz alkali
3	rinse	90–100	12	39	5	
4	rinse	90–100	12	39	5	
5	rinse	90–100	12	39	5	
6	rinse	90–100	12	39	5	
7	sour	90–100	5	21	5	sour to pH 5.0

TABLE IV
Woolwash

No. of bath	Kind of bath	Temp (°F)	Water (inches)	Water added (gal)	Time (min)	Amount and kind of supplies
1	suds	90–100	10	104	5	24–32 oz neutral, low to medium titer soap or synthetic detergent
2	suds	90–100	10	80	5	none
3	rinse	90–100	12–14	93–107	2	
4	rinse	90–100	12–14	93–107	2	
5	rinse	90–100	12–14	93–107	2	rinse until free of soap, two rinses often sufficient
6	sour	90–100	10		2	sour to pH 5.0 (souring optional)

Wash wheels used for washing wool are built with a wide clearance between the cylinder and the shell so as to increase the amount of water present in the wheel at any given water level and the ratio of water to load will therefore be much higher than in the case of the other washing procedures given above. Wool loads generally weigh less than the rated capacity of the wheel used so that in practice the total water present in the wheel on any one operation will vary between 1.0 and 1.5 gallons per pound depending on the loading and water level used.

The soap used is a neutral low to medium titer soap (20° to 30° C) or a synthetic detergent.

The soap is put into solution before work is placed in wash wheel and wheel is stopped between dump and fill. When fabrics washed are not 100% wool, the use of a mild alkali, such as modified soda, is often desirable.

III. HOME-LAUNDERING PROCEDURES

Home laundering equipment varies considerably in type of mechanical action used in accomplishing the laundering process. The most common types of mechanical agitation used are agitator, tumbler, pulsator, bouncing basket, undulator, and X-Centric agitator. In the home-laundering procedures given in Tables V-VIII, the machines are classified only as "automatic" or "non-automatic", with no reference to the type of mechanical action.

Also, it is well to point out that the amount of water listed under the heading "water added" varies with different machines at full loads. In some machines the amount of water can be regulated to correspond to the load size.

Table V outlines a procedure for machine-washable white or fast color fabrics constructed in such a manner

TABLE V

Procedure for machine-washable white or fast color fabrics constructed in such a manner as to withstand a high degree of agitation

Machine	Kind of bath	Temp (°F)	Machine load & water added	Time (min)	Amount and kind of supplies	Comments
Automatic	suds	140–160 (1) (3)	7–9 lbs, 7–17 gals (2)	10–15	approximately ⅔ cup (minimum) of dry detergent or soap, or ¼ to ½ cup of liquid detergent or soap (4); bleach according to directions on container	4 min spinning time between wash and rinse
Nonauto-matic	suds	120–160	7–9 lbs, 14–17 gals, less load-less water	10–15	approximately ⅔ cup (minimum) of dry detergent or soap, or ¼ to ½ cup of liquid detergent or soap (4); bleach according to directions on container	
Automatic	rinse	95–105 (3)	spray and at least one deep rinse	6–12		5 min agitation followed by 4–7 min final spin time
Nonauto-matic	rinse	95–105	at least two in laundry tub	5–10		run through wringer or spinner basket

TABLE VI

Procedure for machine-washable fabrics of moderate colorfastness constructed in such a manner as to withstand a medium degree of agitation

Machine	Kind of bath	Temp (°F)	Machine load & water added	Time (min)	Amount and kind of supplies	Comments
Automatic	suds	120–130 (3)	7–9 lbs, 7–17 gals (2)	5–10	approximately ⅔ cup (minimum) of dry detergent or soap, or ¼ to ½ cup of liquid detergent or soap (4)	4 min spinning time between wash and rinse
Nonauto-matic	suds	120–130	7–9 lbs, 14–17 gals	5–10	approximately ⅔ cup (minimum) of dry detergent or soap or ¼ to ½ cup liquid detergent or soap (4)	
Automatic	rinse	95–105 (3)	spray and at least one deep rinse	6–12		5 min agitation followed by 4–7 min final spin time
Nonauto-matic	rinse	95–105	at least two in laundry tub	5–10		run through wringer or spinner basket

TABLE VII

Procedure for machine-washable fabrics that require care in handling because of fabric or garment construction

Machine	Kind of bath	Temp (°F)	Machine load & water added	Time (min)	Amount and kind of supplies	Comments
Automatic	suds	95–105 (3)	7–9 lbs, 7–17 gals (2)	3–10	approximately ⅔ cup (minimum) of dry mild soap or detergent, or ¼ to ½ cup of liquid detergent or soap (4)	3 min spinning time between wash and rinse
Nonauto-matic	suds	95–105	7–9 lbs, 14–17 gals, less load—less water	3–10	approximately ⅔ cup (minimum) of dry mild soap or detergent, or ¼ to ½ cup of liquid detergent or soap (4)	
Automatic	rinse	95–105 or cold depending on type of machine used (3)	spray and at least one deep rinse	6–12		5 min agitation followed by 4–7 min final spin time
Nonauto-matic	rinse	95–105 or cold depending on type of machine used	at least two in laundry tub	5–10		wring

NOTES (TABLES V–VII):

(1) A large percentage of the automatic washers admit straight hot water to the machine at the beginning of the washing cycle and do not provide for any adjustment of the temperature with cold water. In such cases the temperature of the first step in the cycle is determined by the temperature of the hot water supplied at the tap.

(2) The amount of water added is determined by the type and the capacity of the machine.

(3) Not all machines have automatic controls to regulate the temperature within these limits and, therefore, considerable temperature variation can occur with this classification of fabrics.

(4) The amount of soap or detergent necessary is dependent on water-hardness, kind of soap or detergent used and soil present in the clothes.

as to withstand a high degree of agitation.

Table VI outlines a procedure for machine-washable fabrics of moderate colorfastness constructed in such a manner as to withstand a medium degree of agitation.

Table VII outlines a procedure for machine-washable fabrics that require care in handling because of fabric or garment construction.

On some machines there is a scaled-down time cycle, in which the maximum wash time might be on the order of 3-5 minutes, the rinse agitation time will be approximately two minutes, and the spin time appropriately scaled down. Moreover, some machines have controls which can be operated at the discretion of the operator to give either a fast or slow agitation and spin. These additional controls are useful, especially in the laundering of machine-washable woolens and other fabrics which require special care.

Table VIII outlines a procedure for garments which as washed by hand because of low colorfastness, fabric or garment construction.

IV. DRYING PROCEDURES IN COMMERCIAL LAUNDRY

Flat work, such as sheets, pillow cases and table linens, is extracted after washing to a moisture content of approximately 50% of the weight of the dry fabric and then ironed at that moisture content on a flat-work ironer, which is steam heated to a temperature of approximately 330°F.

Body clothes which require ironing are finished on a steam-heated press after extraction. Such presses operate at a temperature of approximately 330°F.

Knit goods, terry towels and other articles which the customer prefers to have tumbled are dried after extraction in steam-heated tumblers.

V. DRYING PROCEDURES IN THE HOME

TUMBLE DRYING——Either a gas- or an electrically heated dryer is used. After the clothes have been removed from the damp dry spin, they are placed in the dryer at suitable temperature and allowed to tumble dry.

LINE DRYING —— After the spin-dry cycle or after wringing, the clothes are hung on a line either out of doors or inside to dry. *Note:* After

TABLE VIII
Procedure for garments which are washed by hand because of low colorfastness, fabric or garment construction

Machine	Kind of bath	Temp (°F)	Machine load & water added	Time (min)	Amount and kind of supplies	Comments
Hand wash	suds	90–100		2–3	suds of mild soap or synthetic detergent	none
	rinse	90–100	3 rinses or until detergent is removed	5		

hand washing, some items are rolled in a bath towel to remove the excess moisture.

DRIP DRYING——Some items are removed from deep rinse or re-wet after completion of spin-dry cycle and hung on plastic hanger to dry.

VI. PRESSING OR IRONING

HAND IRONING——*Dry:* Garments are removed from the tumble dryer or from the line before they are thoroughly dry and pressed by hand. If garments are allowed to dry thoroughly, they are dampened and then pressed by hand. *Steam:* Garments that have been drip dried are touched up with a hand steam iron.

MACHINE PRESSING——A flat-bed press or a rotary-type ironer are used to press garments either before they are thoroughly dry or after they have been dampened.

CONCLUSION

The level of washability which a fabric will withstand satisfactorily depends upon the fabric properties, the manner in which it is dyed, and the finishing treatments which it receives in the mill. The amount and type of soil picked up by a textile article will be determined by the conditions arising in consumer use; which will, in turn, indicate the type of washing process which must, on the average, be used for adequate soil removal.

It is important that the textile industry take into consideration these factors when choosing the base fabric and selecting the dyeing and finishing techniques.

The information with regard to washing was assembled primarily as an aid in developing new shrinkage methods, but it was the consensus of the Committee that this information would also give the textile industry a well-rounded picture of the conditions which a fabric should be prepared to meet under service conditions.

AATCC SUBJECT AND SPEAKERS BUREAU

The Subject and Speakers Bureau Committee of AATCC is now soliciting additional papers to augment its current file of available subjects and speakers.

Quarterly, a listing of these subjects is circulated to all local sections of AATCC, with an invitation to local section program chairmen to contact the speakers for section meetings. This file now consists of more than 50 subjects, and many sections have benefited from this service.

Those who have papers ready or in the process of preparation are invited to submit an abstract of the paper to the chairman or other members of the Committee.

Papers of a general nature, as well as technical papers, will be acceptable.

SUBJECT AND SPEAKERS BUREAU COMMITTEE

Matthew J Babey, *chairman*
P O Box 205
Bound Brook, NJ

Richard R Frey
AATCC Headquarters
P O Box 28
Lowell, Mass

James A Doyle
American Dyestuff Reporter
44 East 23rd St
New York 10, NY

Charles A Whitehead

Textile Processing Chemicals——

(Concluded from page P182)

as Dacron-cotton blends and other synthetic yarns and blends.

GROWTH FACTORS —— A prime factor in the growth of chemicals usage in all areas of industry has been the increasing expenditure of money for research by the chemical industry itself. This expenditure is currently growing at an annual rate of 14 percent, and in 1955, it was of the order of $250 million. A second major factor has been the cooperation in research effort between the consuming industries and the chemical suppliers. We look for this sort of cooperative effort to be increasingly evident in the textile industry in the years immediately ahead. The laboratories of the chemical companies are anxious to learn the problems of the textile industry and to join in an all-out effort to achieve their solution. With this intensive effort, it is safe to assume that the use of textile processing chemicals is entering an era of rapid growth that will substantially benefit not only the textile and the chemical industries, but most important of all, the consumers of the products of both industries.

BIBLIOGRAPHY

(1) *Chem Eng News*, August 5, 1957.
(2) "Inter-industry Relations Study," Bureau of Labor Statistics (1947).
(3) "Minerals Yearbook" (1953).
(4) Perry, "Chemical Business Handbook," McGraw-Hill (1954).
(5) "Chemical Economics Handbook," Stanford Research Institute.
(6) "Synthetic Organic Chemicals, 1955," Tariff Commission, U S Department of Commerce.
(7) "Facts for Industry Series," U S Department of Commerce.

ACKNOWLEDGMENT

The author wishes to acknowledge the thoroughgoing cooperation of Miss C Seidel of the Market Research Department of Union Carbide Chemicals Co, who developed the statistical and tabular information contained in this paper. He also acknowledges the invaluable assistance of J T Adams and W R Martin in obtaining the detailed data cited on warp sizing.

VOLUME 3

COLOUR INDEX

IS HERE

ORDER NOW!

Rhode Island Section———

PRINTING WITH EMULSIONS*

R D GREENE
Dyes Department
American Cyanamid Company
Bound Brook, NJ

INTRODUCTION

PRINTING thickeners have been the subject of much discussion and investigation over a period of years. The shortcomings of materials available for this purpose have harassed printers continually, and the search for improved carriers is never abandoned. Suppliers of gums, starches and related products are busily engaged in developing new materials to satisfy the needs of the printer. From a production standpoint, experimentation with thickeners is slow and costly, and laboratory work is inconclusive unless confirmed by extensive trials on a practical scale. A thickener thus remains in established use provided it is acceptable in performance and reasonable in cost.

The use of emulsions for obtaining viscosity has been proved very satisfactory in resin-bonded pigment printing. Naturally, the use of this mechanism for application of other colorants immediately suggests itself. Here, however, instead of the relatively inert resins and pigments, a wide variety of chemicals are encountered, many of which are inimical to emulsion stability.

Both forms of emulsions, water-in-oil and oil-in-water, have been developed. The oil-in-water emulsion has proved to be the more interesting from a practical standpoint. Since most colors and chemicals to be used are water-soluble or water-miscible, their introduction into the aqueous outer phase of the emulsion is more readily accomplished. The possibility of adding to the outer phase of the oil-in-water emulsion materials which promote surface deposition of dye and higher color value also increases its flexibility. With the water-in-oil emulsions, later additions to the inner or aqueous phase are less easily made.

Unfortunately, up to the present time no single emulsion has proved to be satisfactory for all classes of dyes. This would of course be highly desirable, as it would be in the case of conventional thickeners, and remains a long-range goal. Modifications, therefore, are required for vat, azoic, direct and aniline black emulsions. The selection of the emulsifier and other ingredients must be made to suit the conditions pertaining to the completed printing color.

DISCUSSION

VAT-PRINTING EMULSION ———In vat printing, strongly alkaline, high electrolyte content and strongly reducing conditions are encountered. From a large field of emulsifiers, lignin sulfonic acid salts have been chosen as most satisfactory. Being a highly effective emulsifier, readily soluble in water, commercially available in quantity, and low in cost, sodium lignin sulfonate meets the requirements.

The emulsion is improved with respect to flow and stability by maintaining some degree of viscosity in the outer water phase. Almost any water-soluble or water-swelled material will answer the purpose, provided it is not adversely affected by the chemicals used for vat printing. It is desirable to use a cold-water-soluble thickener furnishing high viscosity at low concentration in order not to lose the emulsion's advantage of low solids. This material should also be readily removed by washing. Carboxymethylcellulose of the high-viscosity type and combinations of this and a natural vegetable product, eg, Guar, thickener appear to be most satisfactory for this purpose.

The carbonate and sulfoxylate are used in the normal amounts determined by plant experience.

Glycerine or its equivalent does not seem to be desirable in the emulsion. The lack of high amounts of water-retaining gums tends to increase halo occurrence in discharge printing. The presence of glycerine serves only to accentuate this halo formation effect and does not, as it usually does in conventional thickeners, contribute to color yield.

Sugar has been found to be an excellent substitute, which increases color yield without adding to the halo problem. The exact function of the sugar is somewhat obscure. Hydrosulfite stabilization through either chemical reaction or protective coating has been suggested. It is also possible that sugar acts to some extent as a drying regulator by virtue of raising the boiling point or lowering the vapor pressure as its concentration is increased during drying thereby maintaining a moisture equilibrium in the print color film in the manner of glycerine.

Lubricants, such as are usually present in vat gums, are not required, as a large amount of mineral spirit is present in the emulsion and print colors run very well.

The inner-oil phase of the emulsion consists of mineral spirit. This serves to produce viscosity in the emulsion. Its solvent value is of little significance as usually there are no solvent-soluble materials used. Mineral spirit of lower KB value and lower cost than is customary for resin-bonded pigment emulsions can be used.

Finally, the addition of sodium hydrosulfite has proved to be of benefit to the color yield. When the emulsion has been standing for 24 hours, the color value obtained from it is higher than that obtained from a freshly prepared emulsion. The addition of sodium hydrosulfite brings about this gain in color value almost immediately. This is of particular value in preliminary trials where freshly made emulsion might be used. In production, it is more likely that stock emulsion would be made up in advance.

The proportions recommended for an emulsion of good body and flow are shown in Table I.

TABLE I

	Standard Emulsion	*Reduction Emulsion*
Water	5½ gal	5½ gal
Sodium lignin sulfonate, 40% solution	5 gal	5 gal
Carboxymethylcellulose, high viscosity, 4% solution	6½ gal	6½ gal
Guar[1], 2% solution	4 gal	4 gal
Potassium carbonate	33 lb	—
Sodium carbonate	—	18 lb
Sodium sulfoxylate formaldehyde	40 lb	18 lb
Sugar	20 lb	20 lb
Mineral spirit	11 gal	13 gal
Sodium hydrosulfite	6 lb	6 lb
	40 gal	40 gal

[1]Morningstar, Nicol, Inc.

* Presented October 24, 1957 before the Rhode Island Section at the quarters of the Providence Engineering Society, Providence, R I.

NOTE: Nothing contained herein shall be construed to imply the non-existence of any relevant patents nor to constitute a permission, inducement or recommendation to practice any invention covered by any patent owned by American Cyanamid Company or by others, without authority from the owner of the patent.

Stock solutions of the sodium lignin sulfonate, carboxymethylcellulose and Guar may be used to advantage, as indicated in the foregoing formula. These may be prepared in large quantities in advance, as a time-saving expedient, although they may all be dissolved together as the first step in preparing the emulsion if desired. It is important to be sure that the CMC is completely swelled and clear before proceeding with the addition of carbonate and sulfoxylate, as the presence of electrolyte arrests the swelling process.

Potassium carbonate is recommended for the more concentrated standard (or strong) emulsion as it is more soluble than the sodium salt. In view of the smaller amount of water available than is found in gum thickeners, there is danger of crystallizing-out of soda ash. The carbonates and sulfoxylate may be added as concentrated solutions if desired, although both dissolve so readily that they may be added dry to the batch. The sugar dissolves readily and presents no problem.

All of the water-soluble ingredients discussed up to this point can be dissolved with ordinary stirring apparatus, such as propellor or paddle-blade stirrers. The addition of the mineral spirit during the emulsification step must, however, be carried out using suitable homogenizing equipment.

EMULSIFYING EQUIPMENT ———For the formation of the emulsion, homogenizing equipment providing a high degree of mechanical action is required. High-speed shearing tools are familiar to most printing plants where resin-bonded pigments are in use. These operate on the principle of turbine-like rotors, which revolve at high speed, breaking up the inner phase into minute droplets. Excellent emulsions are formed. The practical objection to such equipment is that the emulsion must be made on a batch basis and, unless oversize equipment is installed, production is limited.

A somewhat better procedure is to form a coarse emulsion with blade or propeller stirrers and pass this through a colloid mill. The emulsions so produced are fully satisfactory but the batch operation is still required.

Other homogenizers, such as the ultrasonic, are available, in which the inner and outer phase of the emulsion are simultaneously introduced into the emulsification chamber at a predetermined ratio. Premixing is thus eliminated and a continuous flow of finished emulsion is obtained from previously prepared stock solutions.

In any case, the fineness and uniformity of the emulsion is important to its stability and performance. Careful attention should, therefore, be given to the mechanical setup.

Properly prepared emulsions have excellent stability and show no deterioration after standing several months.

PRINT-COLOR PREPARATION ———Print colors are prepared by adding the required amount of vat printing pastes to the emulsion. Thorough stirring is desirable, as in the case of gum colors, and is best accomplished by the use of a propellor-type power stirrer. Homogenizing high-speed stirrers may be used for this purpose but are not essential. Most vat printing pastes may be used with the emulsion. A few individual colors have been found to break the emulsion as they apparently contain solvents or printing aids which are not compatible.

The running properties of the emulsion are excellent in regard to both color and lint doctoring. The levelness of the larger printed areas is superior to that of the usual gum color even in the case of lighter engraving. Fully satisfactory blotches have been printed with 45-line engraving intended for pigment printing, while much heavier (approx 36-line) blotches are usually considered necessary on heavier fabrics.

The absorption of the low-solids emulsion colors by the fabric is rapid and permits much sharper fall-on effects free from the normal squashed-out effect. The rapid absorption and breaking of the emulsion as it is taken up by the fabric makes the color film less mobile and less susceptible to the flattening effect of crush. The colors are bloomier and often brighter than corresponding gum colors.

Color yield with emulsion colors is usually found to be equal to or superior to gum colors. Against the highest color yield gums. the color cost is approximately parallel, so that the improvements in running properties and quality of the prints may be had for no extra expense.

Because of the use of the substantial amount of mineral spirit, drying of the prints is more rapid, permitting increased speeds where the weight of the fabric might be a limiting factor.

Aging time required for emulsion prints is shorter than for gum color prints. Full details of exact comparisons are not available, but indications are that the aging time for heavy fabrics may safely be reduced from eight minutes to four or five minutes without adverse effects. This is probably explained by the increased accessibility of the chemicals and dye to the steam without the impeding presence of high amounts of gum solids.

The same accessibility leads to more rapid oxidation and more efficient washing. With no substantial amount of gum or starch to soften and remove, action on the dye and complete removal of unfixed color is readily accomplished. Particularly in the case of resin finishes, where full penetration of the resin is essential to give optimum crease resistance or similar effects, the clean prints obtained from emulsion printing sometimes actually reduce the amount of resin required. The ready removal of unfixed dye and absence of colored gums improves the quality of the white ground by virtue of decreased staining back in the soaper.

SCREEN PRINTING———In the case of screen printing, the use of the emulsion enables the printer to proceed with printing with practically no interval between filling-in or laying-on the second and successive colors. The emulsion strikes into the fabric rapidly without leaving the shiny, wet, sticky color on the surface. Colors falling-on are smooth and sharp, as the blocking effect of underlying colors is not encountered.

FLASH AGING——— Vat printing for flash aging development may be done to advantage with an oil-in-water emulsion. In the old process the thickener served a double purpose: 1) to produce printing viscosity, and 2), to serve as a temporary binder during the padding and steaming operations. Thickeners that meet these requirements are limited in number and, in general, poor as regards color yield. It has been found that an emulsion will give excellent performance as well as considerably higher color yield.

A small amount of alkyd resin in conjunction with sodium lignin sulfonate is used as the emulsifying agent. The amount used does not bring about any sticky residue in washing equipment.

Cold-water swelling gums are used for the control of viscosity. They are readily removed in washing.

A typical formula for a flash-aging emulsion is shown in Table II.

The gums are swelled in cold water until clear. The resin is thinned with the xylol and stirred in with homogenizing stirring. The mineral spirit is likewise added.

Prints made with the emulsion are rapidly absorbed by the fabric and dry more rapidly. Fall-ons are sharp and blend evenly with the underlying color. Excellent levelness and coverage are obtained.

The use of the emulsion for vat printing shows a great deal of prom-

TABLE II
Formula for flash aging emulsion

Modified locust beam gum	3 lb
Starch ether gum	3 lb
Sodium lignin sulfonate	¾ lb
Water	16 gal
Aerotex Resin P116[1]	12 oz
Xylol	1 gal
Mineral spirit	21 gal
	40 gal

[1]American Cyanamid Co

TABLE III
Azoic printing emulsion

Carboxymethyl Cellulose HV 120[1] or Keltex S[2], 4% solution (stabilizer)	18 gal
Decceresol Wetting Agent No. 18[3]	3 pt
Caustic soda, 25% solution	9 pt
Mineral spirit	20 gal
Oleic acid	9 pt
	40 gal

[1]Hercules Powder Co
[2]Kelco Co
[3]American Cyanamid Co

TABLE IV
Aniline black emulsion formula

Water	24 gal
Sodium chlorate	12½ lb
Yellow prussiate of soda	25 lb
Octyl alcohol	1 pt
Modified locust bean gum	3 lb
Marasperse N[1]	7 lb
Mineral spirit	15 gal
	40 gal

[1]Marathon Corp Chemical Div

ise in its early stages. There is no doubt that additional progress will be made as further experience is gained. Contrary to many improved methods, the manifold advantages of the emulsion may be had without extra cost, which is presently, more than ever, an important factor.

EMULSIONS FOR AZOIC DYES ——In another very important field, the use of emulsions for printing is of great interest. Azoic dyes are widely used, particularly in lines where high production rates and low costs are vital. Also, much of this type of work goes into permanent finish where severe washing is required to remove all starches and gums in order to obtain an effective resin treatment. In flannel printing, a soft hand is desired with a minimum of washing in order to preserve the nap.

To all of these problems, the emulsion offers at least a partial solution or substantial improvement over conventional methods. Much remains to be accomplished in practical use of the emulsion, as the azoic dyes are commonly printed along with other types of colors in multicolored patterns. The unavoidable contamination from preceding rollers leads to some difficulties of stability. The variety of ingredients encountered in both the azoic and accompanying colors may easily bring about a condition under which the emulsion will not remain stable. The search for maximum resistance to such destructive influences is still being actively pursued.

The emulsifier we have found to be best for forming an oil-in-water emulsion for azoic dyes is an amine derivative of a sulfodicarboxylic acid*. This forms an excellent emulsion for printing azoic colors but requires a supplementary emulsifier to overpower the emulsion-breaking solvents introduced by contamination from resin-bonded pigment compositions. The use of oleates is indicated for this purpose. (See Table III).

Dilution of Decceresol Wetting Agent No. 18 is recommended as this material is a paste and is more easily incorporated in the carboxymethyl cellulose solution when thinned with water.

The mineral spirit is added with high speed homogenizing.

Prints made with the emulsion have been found to run very well in the machine, clean well and give an excellent sharp mark. Excellent coverage and level prints are achieved even with lighter-than-normal engravings.

Drying is faster, permitting increased printing speeds.

The ready accessibility of the dye to acid steam makes possible a speed-up of aging and a more complete development of color.

Washing is greatly facilitated, as the unattached color comes off readily in the first rinse and allows the succeeding soap baths to remain cleaner and stain the ground to a considerably less extent. The softness of hand of the prints before washing is remarkable. This is of particular interest in the printing of flannel, where washing is kept at a minimum or in some cases omitted altogether to avoid matting the nap.

A few azoic colors have been found to be incompatible with the emulsion due to the presence of solvents or other materials which break emulsions. The great majority of products on the market are satisfactory.

EMULSION FOR ANILINE BLACK——Aniline black may be printed from oil-in-water emulsion with the attendant advantages of improved running and easier washing properties. The low gum content allows freer access of steam, which not only develops the black more thoroughly, but allows the liberated gases to escape more easily, lessening the tendency to form rosaniline. Chroming and soaping are also facilitated and removal of thickener is more complete. No aniline oil may be added or the emulsion will break. However, certain fiber-protective agents to prevent tendering by aniline black, eg, an organic amine salt of a volatile acid, may be tolerated.

The aniline black emulsion is made, as in the case of gums, by preparing a prussiate and chlorate emulsion to which is added the required aniline salt when ready to use. Both the prussiate emulsion and the print color are of adequate stability. (See Table IV).

The chlorate and prussiate are dissolved hot in about one-third of the water. The balance of water is added cold. The locust bean gum and Marasperse N, a sodium lignosulfanate, are added and stirred until clear. The octyl alcohol may be omitted if experience proves that introduction of air is not a problem.

The mineral spirit is added with homogenizing stirring.

Print color is made by adding aniline salt dissolved in cold water.

Print Color

10½ gal	prussiate emulsion
10 lb	aniline salt
1¼ gal	water

The use of emulsions as print carriers shows a great deal of promise. While a revolutionary change in printing techniques is not anticipated, it is safe to predict that the emulsions will prove to be of help in many instances. The improved working properties and economy have been welcomed by many printing establishments.

ACKNOWLEDGMENTS

Much credit is due Arthur Klein, manager of the Dyes Application Laboratory, and Edward Scott for their part in the preparation of the data and assistance without which this presentation would have been impossible. Thanks and appreciation are also extended to all other personnel who have contributed their part in the development program on this subject.

TRADEMARKS

Aerotex and Decerosol are registered trademarks of American Cyanamid Co; Keltex is a registered trademark of Kelco Co; Marasperse is a registered trademark of Marathon Corp Chemical Div; and Guar is a trademark of Morningstar, Nicol, Inc.

*U S P 2,252,401.

Dyeing of Filament Nylon—

(Concluded from page P186)

number of fabrics can be obtained from high-temperature dyeing on a machine such as the Burlington Pressure Dye Machine.*

Both the cationic- and the anionic-agent dyeing procedures can be used at elevated temperatures. There is no great difference in the results from the two procedures under these conditions; however, direct comparison on mill scale dyeings gives a slight edge in streak coverage to the anionic process. This is understandable since, in addition to the mechanisms described above, the degree of transfer obtained with the Duponol D Paste is increased appreciably over that obtained at lower temperatures.

DYE SELECTION———The same dyes recommended above for use with the cationic agent procedure at temperatures below the boil (Table I) are effective at elevated temperatures. With the anionic agent-assisted dyeings at 235-250°F, this list can be expanded for dyeing dark shades to include:

*Burlington Engineering Co, Inc, Graham, NC.

	New CI	*Old CI or Pr*
Du Pont Milling Red SWB	—	430
Pontacyl Fast Blue 5R	—	289
Acid Green 25	61,570	1,080
Acid Black 52	15,711	Pr 143

Extensive comparisons have demonstrated that the use of 2% Duponol D Paste at 235-250°F produces levelness equivalent or superior to cationic agent-assisted dyeings at the same temperatures. Under these conditions the anionic agent is useful in making all shades.

CONCLUSIONS

The various processes for the level dyeing of filament nylon have been discussed and the following major conclusions reached:

1) It is possible to approach disperse dye levelness with selected acid dyes using the described level dyeing processes.
2) At temperatures below the boil, the cationic agent process gives more level dyeing than procedures using an anionic agent. However, at 235-250°F, the latter process is superior. In all cases improved levelness is obtained by increasing the dyeing temperature.
3) Fabrics which will not dye levelly with disperse dyes cannot usually be dyed without streaks using acid dyes by any of the commercially accepted procedures. Solvent dyeing can be used to advantage in some of these cases.

ACKNOWLEDGMENTS

The authors wish to thank J F Laucius and R A Kasey for their guidance and assistance in this work and B H Stretch for her assistance in tests to define the mechanism of the cationic agent-assisted process.

TRADEMARKS

Benzyl, Cibalan (Ciba); Celanthrene, Pontacyl (Du Pont); Nylanthrene (Nyanza); Supernylite (Althouse); Versene (Dow Chemical)

REFERENCES

(1) Anon, *Tech Bull (du Pont)* **12**, 19 (1956).
(2) MacGregor, J H, US Pat 2,871,536 (Courtaulds, March 13, 1945).
(3) Hindle W H, *Am Dyestuff Reptr* **45**, P972 (1956).
(4) Brooks, J A, and Reith, J E, *ibid* **44**, P698 (1955).
(5) Remington, W R, and Gladding, E K, *J Am Chem Soc* **72**, 2553 (1950).
(6) Vickerstaff, T, "The Physical Chemistry of Dyeing" 2nd Edition, p452 (1954).
(7) McGrew, F C, and Sharkey, W H, US Pat 2,459,831 (Du Pont, Jan 25, 1949); US Pat 2,499,787 (Du Pont, Mar 7, 1950)
(8) Anon, *Tech Bull (du Pont)* **10**, 32 (1954).
(9) Anon, *ibid* **11**, 133 (1955).

A Summary of an Address by Gerald Laxer before the Mid-West Section

"Today's wool can be processed to give performance never before known for the fiber," according to Gerald Laxer, director of the Department of Science and Technology of The Wool Bureau, Inc.

"Modern wool suits can be spot-proof, so that water- and oil-borne stains will bounce off a man's lapel like water off a duck's back," he stated. "Wool clothing can be permanently mothproofed at no extra cost to the consumer. And within six months we can expect to see men's wool suits with durable creases in the trousers and women's skirts with pleats that may last the life of the garment."

Speaking at the Bismarck Hotel, Chicago, Ill, on Feb 15 before the Mid-West Section, AATCC, Dr Laxer said that scientists all around the world are working to produce "easy care" wool garments—that is, wool suits and dresses which require a minimum amount of pressing and which may actually be washed in the home washing machine without fear of shrinkage.

"Numerous major research projects on wool are under way in this country, aimed at producing wool fabrics with all the easy-care performance features which the public demands today," Dr Laxer said. He gave details on three which are sponsored by The Wool Bureau. The newest of these, motivated by the growing trend to "wash 'n wear" apparel, is now under way at the Harris Research Laboratories in Washington, DC. Experiments there are aimed at "engineering" wool fabrics to be washable in home washing machines without fear of shrinkage due to felting.

"From the standpoint of the user, a wool fabric that has been "engineered" to be shrink resistant is more desirable than one which has been only chemically treated for the purpose because chemical treatments alone frequently have an adverse effect on the desirable natural properties of wool. The discovery that certain wool fiber types show a natural resistance to shrinkage and that yarns and weaves can be constructed to achieve great fabric stability suggest the possibility that there will, in time, be men's all wool suits which carry the washable label.

"It sounds like a paradox, but the ideal fabric which the Wool Bureau is working toward is one which will hold a crease permanently and which at the same time cannot be wrinkled."

Permanently creased wool trousers and permanently pleated wool skirts for women will shortly be a commercial fact, according to Dr Laxer; he hopes that before too long he will be able to say the same for permanently crease-resistant wool suits and dresses.

Fabric Research Laboratories, Inc, is currently working under Wool Bureau auspices, to create lightweight wool-worsted suiting fabrics which will be highly wrinkle-resistant without resort to chemicals which might adversely affect wool's hand. Another attempt to engineer a desirable quality into wool fabrics, the laboratories are studying the influence of fiber properties, yarn structure and fabric geometry on wrinkle-resistance. The success of this project reportedly would have a beneficial influence on the summer wool-worsted suit business in particular and on all-wool suit business in general.

The longest-running research in this country sponsored by The Wool Bureau is that at the Textile Research Institute at Princeton, NJ. Now in its fifth year, this study has the purpose of finding out the effect that fiber characteristics—such as crimp, length, diameter, etc—have on fabric performance and on the manufacturing processes. This research, according to Dr Laxer, has produced much valuable information, some of which reportedly is already being applied by mills to produce superior wool fabrics, to produce them more efficiently, and in a shorter time.

ACTIVITIES OF THE LOCAL SECTIONS

Washington

The Washington Section held its first meeting of the 1958 season, February 21, at the National Institute of Drycleaning, Silver Spring, Md, with Chairman George Fulton presiding.

Forty-six members and guests were present to hear two speakers discuss the newest developments in wash-wear garments. Robert T Graham, supervisor, textile and product testing, National Institute of Drycleaning, described "A New Method of Application of Wrinkle-Resistant and Crease-Retentive Finishes to Cotton Garments Using Drycleaning Plant Equipment". Mr Graham illustrated his talk with slides and garments treated by the new technique.

Thomas H McNeill Jr, supervisor, men's merchandising, ably assisted by Claude Lee, supervisor, Technical Service Section, E I duPont de Nemours & Co, Inc, presented a paper entitled "Synthetic Fibers in Wash-Wear Garments". An interesting and informative discussion period was held following the formal presentations.

Following the meeting, refreshments were served in the Institute's Cafeteria.

The next meeting of the section will be held Friday, April 11, at the National Housing Center, Washington, DC, at which time Fred Fortess, Celanese Corp of America, will speak on "New Developments in Chemical Finishing of Textiles".

Niagara Frontier

The Niagara Frontier Section held its first meeting of 1958 on February 21st at the Park Hotel, Clifton Hill, Niagara Falls, Ontario, with 35 members and guests in attendance.

Featured speaker at the meeting was J T Hug, E I duPont de Nemours & Co. Inc, who discussed "The Dyeing of Nylon and Dacron Polyester Fiber Yarns". Mr Hug explained the necessary preparation of filament nylon and Dacron prior to dyeing in package form. The simultaneous twist setting and dyeing of nylon carpet yarns, the dyeing of stretch nylon in muff form, and that of blends with natural fibers was discussed in detail.

Chairman W Leyking read Bernard Easton's report of the January 24th meeting of the Council. An officers meeting was held following the regular technical session.

PTI President Bertrand Hayward welcomes group attending opening lecture of the Spring series on "Colloids and Emulsions".

Delaware Valley

The Delaware Valley Section, AATCC, in conjunction with the Delaware Valley Tanners' Club and the Philadelphia Textile Institute, opened its Spring series of six lectures on the subject "Colloids and Emulsions" on March 3rd at the Institute.

Bertrand Hayward, president of PTI, welcomed the group attending the first lecture, which was presented by Mason Hayek, E I duPont de Nemours & Co, Inc, on the topic, "Basic Principles". The series will run through April 14th.

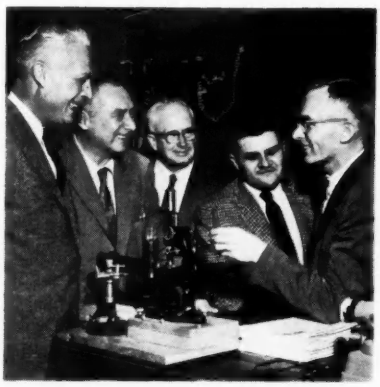


Photo taken at first lecture of the "Colloids and Emulsions" series shows (l to r): Bertrand Hayward, president, Philadelphia Textile Institute; Arthur W Etchells, chairman, Educational Committee, Delaware Valley Section, AATCC; Ward France, dean of faculty, PTI; William S Sollenberger, chairman, Delaware Valley Section; and Mason Hayek, E I du Pont de Nemours & Co, Inc, speaker at the initial lecture.

Metropolitan

The April meeting of the Metropolitan Section, originally scheduled for the 11th at Kohler's Swiss Chalet, Rochelle Park, NJ, has been moved up to the 18th. Peter J Scott, vice president, Tanatex Corp, will discuss "Evaluation of Carriers for Dacron Dyeing".

* * *

Michael F Costello, Jacques Wolf & Co, chairman of the Section's 1958 Outing and Golf Tournament to be held at the North Jersey Country Club, Wayne Township, NJ, on June 6th, has named the following committeemen: Hugh J Bonino, Metro-Atlantic Inc, *dining*; Jack M Schandler, Rohm & Haas Co, *golf*; Chris W Farrell, Althouse Chemical Co, *prizes;* Eugene J Grady, Jacques Wolf & Co, and Gerard Heine, American Aniline Products, *tickets and reservations;* Robert F Holoch, *horseholes;* and Richard P Monsaert Jr, Puritan Piece Dye Works, *publicity.*

In addition to the golf tournament, putting contests, horseshoe pitching contests, swimming, and other events will be conducted. A buffet luncheon is scheduled at mid-day. Following dinner (roast beef or lobster), prizes will be awarded.

Chairman Costello is urging members to send their requests for tickets as soon as applications are received. Many members were disappointed last year as the outing was completely subscribed to two weeks before the outing date.

WESTERN NEW ENGLAND SECTION MEETING
January 31, 1958 • Rapp's Restaurant • Shelton, Conn.
(Photos courtesy of A N Henschel)

WNE SECTION OFFICERS FOR 1958—Seated (l to r): Peter P DuBiel, Cheney Bros Inc, treasurer; Andrew W Goodwin, Princeton Knitting Mills, Inc, vice chairman; John J Cervini, Cheney Bros Inc, chairman; Timothy J Horan, Princeton Knitting Mills, Inc, secretary.

Standing (l to r): John E Hirn Jr, National Aniline Div, sectionbl committeeman; Paul W Reeves, Princeton Knitting Mills, Inc, sectional committeeman; John E Hirn Sr, National Aniline Div, councilor; Ernest Otto, Lee Hat Co, sectional committeeman; J Edward Lynn, councilor.

Albert H Rant, Laurel Soap Mfg Co, sectional committeeman, was not present at the time photo was taken.

John A Zelek, Interchemical Corp, delivering his talk, "Progress in Colors for Synthetic Fibers"

HEAD TABLE (l to r): Timothy J Horan, Princeton Knitting Mills, WNE Section secretary; John A Zelek, Interchemical Corp, guest speaker; John J Cervini, Cheney Bros Inc, WNE Section chairman.

VOLUME 3, COLOUR INDEX IS HERE! ORDER NOW!

AATCC Calendar

COUNCIL
May 23 (Philadelphia, Pa); Sept 19 (Charlotte, NC); October 30 (Conrad Hilton Hotel, Chicago, Ill); May 1959 (Montreal, Canada)

NATIONAL CONVENTIONS
Oct 30-Nov 1, 1958 (Hotel Conrad Hilton, Chicago); Oct 8-10, 1959 (Sheraton Park and Shoreham Hotels, Washington, DC); Oct 6-8, 1960 (Sheraton Hotel, Philadelphia, Pa); September 28-30, 1961 (Buffalo, NY)

DELAWARE VALLEY SECTION
April 12 (Ladies Night), May 23 (Outing), Sept 12 (Wilmington Meeting), Oct 17, Dec 5

HUDSON-MOHAWK SECTION
Mar 28 (Jack's Restaurant, Albany, NY); May 16 (Ladies Night, Chelsea House, Tribes Hill, NY); June 20 (Annual Outing, Antler's Country Club, Ft Johnson, NY)

METROPOLITAN SECTION
April 18 (Kohler's Swiss Chalet, Rochelle Park, NJ; June 6 (Outing, North Jersey Country Club, Wayne Township, NJ)

MID-WEST SECTION
April 19 (Netherland Hilton Hotel, Cincinnati, O); June 13-14 (Outing—Browns Lake Resort, Burlington, Wis)

NIAGARA FRONTIER SECTION
Apr 11 (Joint meeting)

NORTHERN NEW ENGLAND SECTION
Mar 28 (Commander Hotel, Cambridge, Mass); May 9 (Lowell Technological Institute, Lowell, Mass); Sept 12 (Outing—Wachusett Country Club, West Boylston, Mass); Oct 17 (QM Research & Development Ctr, Natick, Mass); Dec 5 (Hotel Vendome, Boston, Mass); Jan 16 (Colonial Club, Lynnfield, Mass)

PIEDMONT SECTION
Apr 25-26 (Washington Duke Hotel, Durham, NC); June 6-8 (Outing—Grove Park Inn, Asheville, NC); Sept 19-20 (Hotel Charlotte, Charlotte, NC)

RHODE ISLAND SECTION
Apr 25 (Students Night—Bradford Durfee College of Technology, Fall River, Mass); June 13 (25th Annual Outing—Wannamoisett Country Club); Sept 26 (Management Night—Warwick Country Club); Oct 23 (Providence Engineering Society); Dec 4 (Annual Meeting—Johnson's Hummocks Grille, Providence)

SOUTH CENTRAL SECTION
Mar 29 (Hotel Patten, Chattanooga, Tenn); May 30-31 (Summer outing—Hotel Greystone, Gatlinburg, Tenn); Sept 13 (Hotel Patten, Chattanooga, Tenn)

SOUTHEASTERN SECTION
Apr 19 (Alabama Polytechnic Institute, Auburn, Ala); June 6-7 (Summer outing—Radium Springs Lodge, Radium Springs, Ga); Sept 13 (Ida Cason Callaway Gardens, Chipley, Ga); Dec 6 (Atlanta, Ga)

WESTERN NEW ENGLAND SECTION
May 16 (Ladies Night—Rapp's Paradise Inn, Ansonia, Conn); June 13 (Outing—Wallingford Country Club, Wallingford, Conn); Sept 26 (Hartford, Conn); Oct 24 (Annual Meeting—Rapp's Restaurant, Shelton, Conn); Dec 5 (Rapp's Restaurant, Shelton, Conn)

OLNEY MEDAL AWARD CANDIDATES

THE Olney Medal Award Committee invites Senior members of AATCC to nominate candidates for the 1958 Olney Medal.

The medal is awarded for outstanding achievement in the field of textile chemistry, including the development of chemical agents or chemical processes used in the manufacture of textiles, or methods of their evaluation. Its purposes are to encourage and afford public recognition to such achievements and contributions and to be a testimonial to Dr Louis Atwell Olney in recognition of his life-time of devotion and multitudinous contributions to this field.

Nominations should set forth in detail all facts which qualify the candidate of consideration, with particular reference to published works and professional qualifications.

Previous winners of the Olney Medal are: Milton Harris, William H Cady, Edward R Schwarz, Harold M Chase, Charles A Seibert, George L Royer, Raymond W Jacoby, Werner von Bergen, Roland E Derby, William D Appel, Miles A Dahlen, Walter J Hamburger and P J Wood.

The voting members of the committee on awards are: Percival Theel, *Chairman;* Paul L Meunier, Edward W Lawrence, Milton Harris, President Geo O Linberg, ex-officio.

Nominating letters and complete data should be in the hands of the committee by April 15th. Please address to G P Paine, secretary, Olney Medal Committee, AATCC, Box 28, Lowell, Mass.

PAPERS FOR 1958 CONVENTION

INDIVIDUALS and firms desiring to present papers at the AATCC Convention in Chicago, Oct 30-Nov 1, 1958 should send 100-200 word summaries to:

Leonard J Armstrong
Varney Chemical Corp
Janesville, Wisconsin

before May 15, 1958.

Papers should be of interest to a large segment of the textile industry. Oral presentation should be streamlined to a 20-minute delivery time.

Membership Applications

SENIOR

John Ernyei—Textile lab chemist, Canadian National Railways Dept of Research & Development, Montreal, Que, Canada. Sponsors: T K Merz, I C Tweedy.

Sam Goldman—Plant supt, Master Yarn Dyers, Inc, Coney Island, Brooklyn, NY. Sponsors: N W Akst, L Raposy. (Met).

T P Middlebrooks—Overseer, dyeing & finishing, Jefferson Mills, Inc, Jefferson, Ga. Sponsors: W B Amos, W B Griffin. (S).

L J Todd Morris—Overseer of dyeing, Oregon Worsted Co, Portland, Ore. Sponsors: R E Newman, C Hancock. (PN).

ASSOCIATE

E van den Heuvel—Research chemist, P F van Vlissingen & Co's Katoenfabrieken Ltd, Helmon, The Netherlands.

James N Leonard—Knitwear product control mgr, Catalina Inc, Los Angeles, Calif. Sponsors: W E Kramer, A H Roberts. (PS).

STUDENT

Beryl Bodily—Grad asst, School of Home Economics, Purdue Univ, West Lafayette, Ind. Sponsor: R W Padgett. (MW).

Joan L Mraz—Student, Purdue Univ, West Lafayette, Ind. Sponsor: R W Padgett. (MW).

Robert L Samson—Student, Philadelphia Textile Inst, Philadelphia, Pa. Sponsor: W H Hughes. (PTI).

TRANSFER TO SENIOR

Charles D Flamand—The Chemstrand Corp, Pensacola, Fla. Sponsors: S Brodie, C W Kennedy. (S).

Charles W Funderbunk—Dyeing & finishing trainee, Elm City Plant, Callaway Mills, La Grange, Ga. Sponsors: W B Griffin, W M Slaughter. (S).

Harry Weisberg—Research chemist, Londat Aetz Fabric Co, Elizabeth, NJ. Sponsors: Z Messinger, K Hahn. (Met).

Employment Register

This column is open for two insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the secretary of the Association, Post Office Box 28, Lowell, Mass. It is understood that these will be open to inspection by prospective employers who can obtain further information from the secretary.

58-6

Education: BS, textile chemistry, New Bedford Institute of Technology, 1950; AATCC Textile Chemistry Award in 1949; Phi Psi Award in scholarship in 1950.

Experience: Dyer; dyer-chemist; plant chemist — dyeing, printing, and finishing natural and synthetic fibers. Resume on request.

Age: 32; married; references.

Position desired: textile chemist; textile sales and service.

Location desired: Northeast; Continental USA acceptable.

3-24; 4-7

THE SECOND EDITION
of
THE COLOUR INDEX
IN FOUR VOLUMES
IS NEARING COMPLETION

Volumes 1 and 2 are being distributed to prepaid subscribers.

VOLUME THREE

is in transit from England and will be delivered to subscribers in March 1958

Volume 4, completing the set, will be ready in the Fall

A LIMITED EDITION
SETS STILL AVAILABLE

at

$112.00 the Set Delivered

Your prepaid subscription received promptly will insure complete delivery this year of this tremendously valuable work on the free world's dyestuffs and pigments in commercial use. Published by the Society of Dyers and Colourists (British) and the American Association of Textile Chemists and Colorists, these four volumes represent ten years of intensive work in assembling and editing the data. They include approximately 3000 pages of application and fastness properties of coloring matters as furnished by world manufacturers, chemical and structural information, characteristic reactions, index of products and trade names, fastness tests and rating methods, new and old COLOUR INDEX NUMBERS, Schultz and AATCC prototype numbers and a Hue Indication Chart.

Further Particulars from

American Association of Textile Chemists and Colorists

PO Box 28, Lowell, Massachusetts

Inter Alia—Inter Nos

P J WOOD

WHAT'S IN A NAME?

For Elmer's benefit, we are constrained to give the meaning of the title of this column, "Inter Alia-Inter Nos," "Among Other Things-Between Ourselves". Of course, we might have called it a lot of other things.

"Obiter Dicta", which we prefer to translate as "Things Said by the Way", although Elmer might like to render it "Unofficial Opinions", giving it what he might call a "wacky" twist, was another title we considered.

Elmer's Latin is not always of the best. He might make lots of other wayward and unorthodox suggestions, if encouraged, so maybe we had better leave it the way it is, failing strenuous objection by some reader, or, worse yet, some good and valued advertiser.

And talking about Latin, the one man among all our friends who seemed to derive more benefit from the Latin he studied at Harvard is J K Milliken, with whom we had the privilege of living for a few months in his very comfortable home in North Dighton. At that time, he was able to quote pages and pages of Latin prose, from memory, and we have no doubt that this distinguished Latin scholar is still able to do this as well as ever he did.

DISPOSABLE

Paper plates have been with us for some time. Although we have to acknowledge the convenience of this atrocity, we still do not like to eat from such ersatz plates, imagining, whether rightly or wrongly, that we can discern a foul flavor in the food thus served. Drinking hot coffee out of a paper cup is anathema to us likewise. Even a cold drink tastes phooey. Another thing we do not like about these disposable items is that the less orderly of our citizens scatter them untastefully over the lovely countryside, from whence they are blown by every vagrant breeze hither and yonder to provide an eyesore for weeks and weeks. But now, we have heard that someone has invented disposable clothing. Ladies dresses indeed. No wonder the textile business is in bad shape. It is to be hoped that these garments will not be scattered, like the paper plates and cups, all over the landscape. Waterproof, so they will not disintegrate under the impact of rain; flameproof in order to avoid danger from ignition; they will also have to be treated in some way so that they will retain a half-way decent appearance during their short existence. Whaddja think of that? Another punch in the solar plexus for the long-suffering dyer. As Elmer says, in his crude way, "There ain't no justice."

NO SOAP!

In all the visits we have made to Paris, we have remembered rarely that hotels in that charming metropolis do not think it is any part of their business to provide soap for their guests, until we arose at the next ante meridian destitute of that very desirable toilet necessity. In fact. the very last time we were there, we used up the better part of a tube of shaving cream (brushless), without too much success, in an attempt to discover a substitute. Whether soap is used as sparingly in private homes, we have no means of knowing, not having made stays other than in hotels.

However, some light may be shed on this matter by the remarks of M Naudet who, writing in the Revue Francaise des Corps Gras, in the May 1955 number says, "Although for some applications synthetic detergents may be preferable to soap, the latter will always remain the most important help to the housewife, providing that its composition be improved and that it be carefully manufactured." Those who have travelled any distance along the banks of the Siene, or any other French river, will remember seeing village women soaping their wash with a bar of soap, wetting slightly and then thrashing the garment on a convenient adjacent flat rock, applying enough horsepower to beat out any dirt by main force, afterwards rinsing in the flowing stream. This might seem to indicate that it may be a long time before these worthy ladies would dispense with the handy soap bar in favor of the synthetic detergent. For this reason, we do not foresee any possibility of a mass migration of the village blanchisseuses to the ranks of the syndet users in France.

Nevertheless, the synthetic detergent business is growing in France, just as it is in the rest of the world.

COLOR

A few weeks ago we came across a report of Miss Margaret Lane, of the British Man-Made Fibers Association, in which she referred to Italian colors.

Our first experience of the trend of taste in colors of Italians was observation, at a very early age, of the silk or cotton head-covering of the female constituent of what looked like married couples of what the English called, "tingalary players". These sturdy couples made their living by pulling the precursor of the player-piano of more recent years, a street piano, up hill and down dale, stopping to play selections at indiscriminately chosen points.

They derived their income from people who paid them to move on (and told them so) and from others who really liked the cheerful jangle of the mechanical piano, which was played by twirling a handle.

The man invariably wore a bright pheasant or other gay feather in the band of his foreign-looking headgear, very much the worse for wear, which he carried on his head at a jaunty angle and doffed with a dazzling smile every time a face appeared at a window or door.

The woman might also sport a gaily printed shawl of the most brilliant colors printed on wool. When we were in the textile printing business, we tried to imitate the vivid colors, as we remembered them, but without too much success.

So, when we saw this article regarding the expression of Miss Lane, in that versatile and newsy journal, The Dyer (London), immediately we wrote to our color expert friend, Miss Estelle Tennis, then executive director of The Color Association of the United States, Inc, asking her "What are Italian colors?"

Said she, among other things, "By an interesting coincidence, it happens, that the advance 1958 Fall and Winter colors for man-made fibers and silk which we are issuing today to our members, contain a feature collection of Italian colors. I am very glad to send you these eight shades. As you will see, they are clear, animated pastels reflecting the influence of sunny Italy. Of course, colors in an even more vibrant range can also be termed Italian".

Here are the intriguing names of this galaxy of happy colors: Como Coral, Roman Blue, Trivoli Green, Italian Lilac, Florentine Pink, Tuscan Melon, Capri Turquoise, Venetian Yellow. Luscious is the word!

BIBLIOGRAPHIES

Toward the end of the Perkin Centennial year (1956), we offered through the press to send, to anyone who would write for it, a copy of a bibliography of books and articles on color and coloring; this we did with the permission of the author, F R Taylor, who is the sublibrarian of the Technical Library of the Manchester (England) Public Libraries. There were requests from 598 individuals asking for 629 copies, which were duly sent out.

Knowing of our interest in languages, Mr Taylor recently sent us a copy of another compilation he has made up on the subject of "Cybernetics", and still another one on "Mechanical Translation of Languages", two subjects that do not seem to have much connection with one another until it is realized that the first subject is defined as being "a new field in science, namely that study of control and communication in living organisms and in machines, with the intention of finding the common elements in the functioning of human nervous system and of automatic machines." Stated differently it is the meeting point of control and communications engineering, neurophysiology and psychology, dealing with human control functions and the mechanical and electrical devices that are presently being invented to replace them.

Our friend F R Taylor has done a thorough job, as usual; these two pieces of information have 144 and 129 references respectively.

Anyone who is interested in either of these subjects is welcome to have either or both of them on loan for a limited period (long enough to copy them, anyway) on request.

What the textile dyer and finisher seems to need most is some machine that would control prices without his volition.——Q.E.F.

• PATENT DIGEST •

PAUL WENGRAF

APPARATUS FOR CONTINUOUS DYEING AND FINISHING OF PILE FABRICS C,6

USPat 2,785,042 (Collins & Aikman Corp—— Grajeck et al——March 12, 1957)

A principal difficulty encountered in the dyeing of pile fabrics is that of carrying out the drying and subsequent finishing procedures without deforming the pile.

The patented apparatus contains, as essential parts, a number of pin rollers (23), one of which is shown in detail in Figure 2. It may be seen from Figure 1 that the fabric passes through a dyeing unit (1) while the dye solution delivered from container (10) is being stirred constantly. The material then travels through an ager (2), entering and leaving the chamber under heated baffles (21, 32), and from there through rinsing units (3, 4, 5, 6), then through a padder (7) to be impregnated with a mothproofing solution, and finally to a drying device. The pin rollers (23) are used to prevent contact of the pile with smooth roller surfaces. Rotary beaters (20, 49, 56) are inserted to beat on the back side of the fabrics in order to reopen the piles after any wet treatment. Excess rinsing water is removed by suction extractors (39, 45, 55) after each passage of the material through the rinsing tanks.

Among the references cited by the Patent Office:

USPat 1,569,785 (Poetzsch/1926) describes a pile-raising machine comprising a plurality of pile-raising rollers, arranged in sets. One of the rollers is movable as a unit toward and from the other set.

Brit Pat 484,991 (Collins & Aikman/1938): a device for dyeing and finishing pile fabrics in continuous operation by padding on the dye, then fixing it in an aging unit, rinsing, drying and raising, napping or opening the pile.

USPat 2,071,922 (Collins & Aikman/1937): similar to the above Brit Pat.

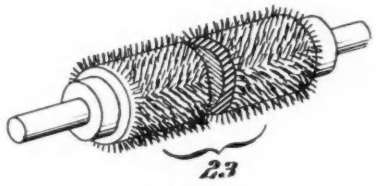


Figure 2
USP 2,785,042

SHRINK- AND CREASE-PROOFING TEXTILES ——Mixtures of Polyepoxides and Polymethylol-substituted Nitrogen Compounds G,2,04

USPat 2,794,754 (Shell Development Co—— Schroeder——June 4, 1957)

This patent is a continuation-in-part of USPat 2,752,269 [cf *Am Dyestuff Reptr* 46, 221 (1957)].

It may be recalled that 2,752,269 protects a shrink- and creaseproofing method which calls for the application of a saturated polyglycidyl ether of a polyhydric alcohol, such as glycerol or diethylene glycol, in aqueous solution. In subsequent acid curing, polymerization occurs. Chlorine retention is completely avoided, it is claimed.

The current patent is concerned with a modification of the above process, that is, the use of mixtures of a polyepoxide material as described in 2,752,269 with methylol groups containing compounds, eg, dimethylolurea, dimethylolethylene urea, dimethylolmelamine, etc. The polyepoxide component amounts to 15-90% of the total mixture. An *acid-acting epoxy-curing catalyst*, eg, zincfluoborate or magnesium perchlorate, is added.

Example: Cotton was treated with a mixture of dimethylolurea and "Polyether A" (a condensate of glycerol with epichlorohydrin) dissolved in isopropanol-water. Borontrifluoride-ammonia was added as a catalyst. After being padded, dried at 60°C for 5 minutes and cured at 160°C, the cloth reportedly exhibited excellent crease- and shrink-resistance. No chlorine retention could be noticed.

Among the references cited by the Patent Office:

USPat 2,541,027 (Shell Development/1951) describes a heat-curable composition consisting of a mixture of a glycidylether of bis (hydroxyphenyl) propane with a phosphonic acid.

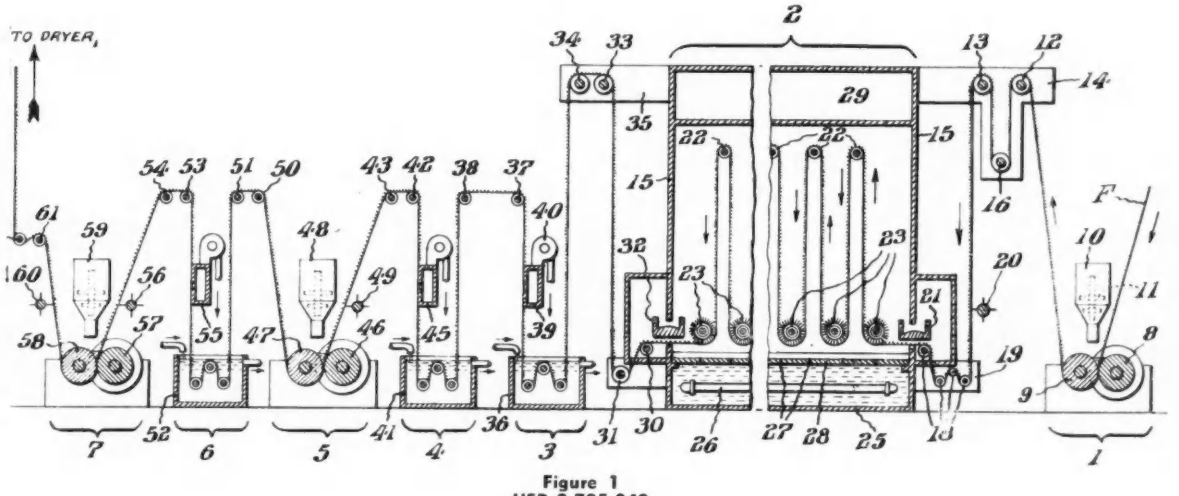


Figure 1
USP 2,785,042

USPat 2,606,810 (Am Cyanamid/1952): shrinkproofing wool with copolymers of unsaturated compounds containing epoxy groups (glycidyl methacrylate) and another different monomer, eg, ethylacrylate [cf *Am Dyestuff Reptr* 42, 213 (1953)].

USPat 2,752,269 (Shell Development/1956): see above.

PERMANENT FINISHES ———Cellulose Esterified or Etherified with Unsaturated Chains in Two Steps G,2,01

USPat 2,789,030 (Cluett Peabody & Co—— Fetscher——April 16, 1957)

The preamble to this specification states that durable or permanent finishes on resin basis hitherto have not been quite satisfactory. Thermoseting resins reportedly are never completely washfast, most of them also displaying some chlorine retention. Thermoplastic-resin finishes produced with emulsions or suspensions are said to exhibit limited durability upon laundering.

The author developed a process which is characterized by the linking of unsaturated chains to the cellulose molecule in one step and the copolymerizing of the thus etherified or esterified compound with other unsaturated polymerizable compounds in a second step. Cellulose is changed "topochemically" in the first step without materially changing the fibers' physical form. The esterifying or etherifying agent preferably is a lower unsaturated acid (up to 5 C, such as acrylic, methacrylic acid, etc) or any of the corresponding unsaturated alchols. This reaction must take place to a *limited degree on the surface only*, without any extensive disruption of the cellulosic body. It is permissible, however, to link one of these substituents to 10-100 glucose anhydride units of the cellulose molecule without causing substantial fiber damage.

The second step comprises a copolymerizing reaction of the compound obtained in the first step with one or more polymerizable monomers. The final effect is demonstrated by the following equation, wherein "A" is the product obtained in the first step (from cellulose and methacrylic acid), "B" is a number of methacrylate molecules, and "C" is the final copolymer resulting in the second step:

The specific effect is that the resin grows in single-chain molecules *at discrete sites* along the surface of the cellulose. There is no accumulation of resin molecules at one spot ("gluing the fibers together"), as would be the case in a treatment with a standard polymeric emulsion. In the present case, the fiber treated in the first step can be combined in the second step with a great number of polymerizable molecules without altering the hand or causing undesired adhesion. The characteristic feature is the solid chemical combination of cellulose and resin, which cannot be destroyed except by hydrolysis of the primary ester or ether linkage.

Example:——(*First step*): Broadcloth soaked in formic acid and squeezed was immersed in a mixture of methacrylic acid, methacrylic anhydride and some perchloric acid. Following the rinsing and drying operations, the content on methacrylic groups was found to be 12-15%.

(*Second step*): The pretreated sample was heated in an emulsion of methylmethacrylate, containing a polymerizing catalyst. Polymerization was complete at 70°C after two hours. The sample had gained 48% in weight; this increase persisted after five hours laundering.

Among the references cited by the Patent Office:

USPat 2,336,985 (Freund/1943): films prepared from unsaturated cellulose esters (cellulose acetate crotonate) further copolymerized with unsaturated vinyl compounds.

USPat 2,455,083 (Pacific Mills/1948): improving the chemical reactivity of cellulosic fibers by reacting the material with 3-4-epoxybutane [cf *Am Dyestuff Reptr* 38, 296 (1949)].

USPat 2,468,716 (Am Cyanamid/1949): reducing the felting or shrinking tendencies of textiles by treating them with a reactive polymerization product, particularly vinyl aryl isocyanate.

Brit Pat 394,722 (Dreyfus/1937): preparing a nitrogen-containing cellulose, dyeable with acid dyes, by first halogenating unsaturated cellulose ethers (allylcellulose) and condensing thereupon with an amine (diethylamine).

SHRINKPROOFING REGENERATED CELLULOSE———

Alkoxymethylene Quaternary Compounds Applied G,2,04

USPat 2,793,929 (Onyx Oil & Chem Co—— Musser——May 28, 1957)

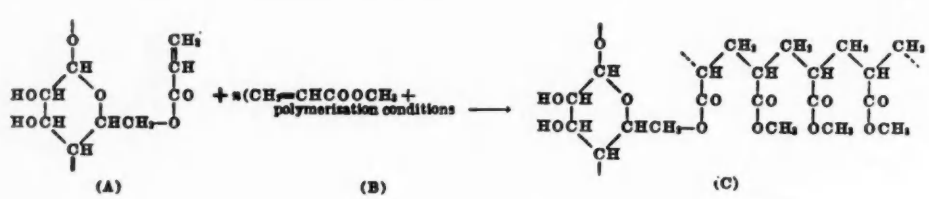
The current patent is a continuation-in-part of USPat 2,681,342, which protects the preparation of quaternary ammonium compounds from anhydrous tertiary amine salts, such as pyridine hydrochloride, a lower alcohol and paraformaldehyde. These compounds reportedly give superior stabilizing effects in comparison with known methods using amino resin condensates or glyoxal.

Reference is made in the current specification to USPat 2,351,581 (Rohm & Haas/1944), which describes a stabilizing treatment of cellulosic textiles with oxymethylated quaternary salts that are etherified with chains up to C_{18}, eg, butoxymethylpyridinium chloride. This is said to cause a lowered moisture pickup and poor, uneven dye absorption.

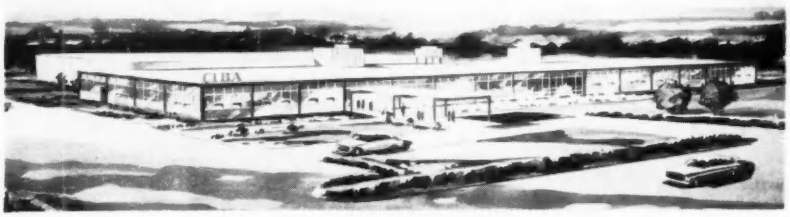
In contrast, shrinkproofed rayon treated according to the current method is claimed to give a desirable hand and improved stability throughout repeated launderings. A hydrochloric or hydrobromic salt of a ternary amine (particularly picoline, pyridine or benzylmethylamine) is formed and evaporated to dryness, then reacted with methanol and formaldehyde under strongly acidic conditions (pH 2-3) at slightly elevated temperatures. Quaternary ammonium halides bearing a methoxymethyl group as a substituent on the N-atom are formed. Although similar products might be obtained by reacting the amine with a chloromethylether, it has been found that the above reaction gives a mixture of byproducts that are apparently essential to the final effect.

Example: Concentrated hydrochloric acid was added gradually to pyridine; the mixture was heated to 200° C to drive off water and excess pyridine. After the mixture was cool, methanol was added and the solution adjusted to pH 2.4. Then paraformaldehyde was stirred in at room temperature for four hours. After the nonreacted ingredients were distilled off, a water-soluble product resulted, which was applied in aqueous solu-

(Concluded on page 210)



News of the Trade



Artist's conception of Ciba Co, Inc's Headquarters Building at Fair Lawn, NJ

Ciba Breaks Ground for New HQ Building in NJ

A new building in Fair Lawn, NJ, for which ground has been broken, will replace entirely the present Greenwich St, New York, facilities of Ciba Co. Inc. Adjacent to the industrial heart of Northern New Jersey and within easy reach of the Toms River, NJ, manufacturing facilities. the erection of a modern, one-story, streamlined building at Fair Lawn Industrial Park will provide the facilities needed for a fully integrated operation to meet the Company's present and future growth.

A leading supplier of dyes, chemical specialties, and plastics, Ciba Co, Inc, in planning the relocation in nearby Northern New Jersey, has placed special emphasis upon the design and equipment of technical laboratories and related facilities.

While many Ciba employees already reside in the Northern New Jersey area, the Company is making special arrangements to help personnel who need to relocate their homes in the residential area of Fair Lawn or in other communities of Northern New Jersey near to the new headquarters.

Handsomely set and landscaped within a spacious five-and-one-half acre tract at Fair Lawn, the Ciba building will occupy approximately 80,000 square feet of the tract with a frontage of more than 700 feet on Route #208. from which there will be direct access to parking facilities for employees and visitors.

Dyehouse Addition to Rabun Mills

A sizable addition is near completion at Rabun Mills, Inc, a wholly-owned subsidiary of James Lees and Sons Co at Rabun Gap, Ga. It reportedly provides space for the blending of wool and man-made fibers, the dyeing of wool and other fibers, and the dyeing of yarns and carpets.

Also being constructed to complement the foregoing operations is an addition to the water-pumping station, a complete filter plant, an addition to the steam power plant and an industrial waste treatment plant.

The original tufting mill at Rabun Gap has been in operation for a year, and the company management has expressed great satisfaction with the progress made to date.

The Rabun Gap facility is built on a 295-acre site, and, when fully completed this year, will have complete dyeing facilities as well as modern fiber-blending and carpet-tufting operations. It has total floor space of over 200,000 square feet and will employ several hundred persons, according to William L Jarrett, plant manager.

Tufted carpets have been taking a larger part of the industry's market each year, and in 1957 it was reported to be nearly one-half of the total American production.

Reliable Sample Card Co Hosts Visitors at New Plant

Reliable Sample Card Company celebrated the opening of its new offices and plant at 30 Sanford St, Brooklyn, NY, this month by hosting approximately 500 members of the textile and allied trades.

A converted foundry renovated at a cost of $400,000, the one-story structure has a working area of 62,000 square feet. It is laid out in assembly line patterns with emphasis on automatic equipment and ease of handling.

Offices occupy 5,000 square feet, while a restaurant on the mezzanine is approximately 3,300 square feet. Plans call for the construction of an adjacent building in 1959.

Irving Warsoff, president of the firm, heads production. Richard Warsoff handles sales and merchandising.

New Divisions Replace Koppers Chemical Div

Two new divisions, the Chemicals and Dyestuffs Division and the Plastics Division, have been formed by Koppers Co, Inc, replacing the Company's former Chemical Division.

Under the new organization, plants at Lock Haven and Petrolia, Pa, will be under the Chemicals and Dyestuffs Division headed by T C Keeling Jr, vice president and general manager. Mr Keeling has been assistant vice president in Koppers' Chemical Division and manager of American Aniline Products, a unit of Koppers Co.

David L Eynon Jr, president of Mobay Chemical Co for the last four years, has resigned that position and on April 1 will become vice president and general manager of the newly formed Plastics Division.

Keeling

Eynon

Sun Chemical Moves Into New Quarters

Sun Chemical Corp, "is at home" as of March 3rd, in a new office at 750 Third Avenue, New York, NY. For the past nine years the corporation has occupied its own building in Long Island City.

All the administrative and executive offices of the corporation are now centralized within 42,000 square feet of floor space in the new thirty-four story building located in midtown Manhattan.

New Dense Soda Ash Plant

Completion of a new dense soda ash plant at Baton Rouge, La, was announced last month by Solvay Process Division, Allied Chemical & Dye Corp. The new facilities more than double previous capacity, it is reported.

The newest addition to the plant constitutes the fourth expansion of soda ash capacity since Solvay began operations at Baton Rouge in 1935.

VDI to Launch Broad Promotion Program

A stepped-up, nationally coordinated advertising, promotional and educational program, aimed at pointing up the practical benefits and economics of true vat colors in apparel and home furnishings fabrics, has been announced by the board of directors of The Vat Dye Institute, Inc.

The 1958 drive, estimated to cost over a quarter of a million dollars, is designed to reach every level of the textile industry from mill executives, finishers and cutters to retail stores and consumers throughout the country, according to Henry Herrmann, executive secretary of the Institute.

Major highlights of the campaign, now already under way, include: national advertising in leading consumer and trade publications to be coordinated with a continuing schedule of significant retail store promotion and merchandising activities; a carefully planned direct mail program; development of sales promotion material; and a strong public relations and publicity program on both consumer and industry-wide levels to tie in with the promotion calendar.

According to Mr Herrmann, the primary purpose of the expanded promotion program is to help educate textile mill and converting people, manufacturers, retailers and consumers of the definite superiorities of vat dyes in dyed or printed cotton, viscose rayon and linen ready-to-wear and decorative fabrics.

"This relates directly with the working goals of the Institute," he said, "especially in demonstrating the actual economy of fabrics colored with vat dyes, and to combat any tendency of subordinating color quality in favor of lower cost."

Important initial step in the new program, the executive reported, will be personal contact with leading mills and finishing plants to promote broader identification of vat colors in finished textile products, including store tags and labels, and to enlist cooperation of their chief executives, designers, advertising and promotional personnel. This takes in colored yarn mills, integrated mills with their own plain dyeing or printing equipment and independent print works and finishing plants.

This contact work will also serve in the development of proposed national trade advertising to feature important leaders in the industry asked to state why they believe vat standards to be the best interest of the trade and the consumer, and why their organizations approve and use vat colors. The program will tie in with the promotional activities of the firms using vat colors.

Consumer advertising will center on publications combining broad readership with acknowledged trade influence, Mr Herrmann pointed out. National magazines will serve as a basis for a continuing consumer educational program as well as provide a series of vehicles for effective retail store promotion efforts tying in vat-dyed merchandise. Women's and children's apparel, work clothing, men's dress shirts, sportswear, knitwear, piece goods, drapery, slipcovers and cotton carpeting will be among the merchandise areas to be covered in the national program.

The Institute's retail store promotion program, designed to bring the full force of the vat color story to the stores' sales floors, takes in a series of seasonal events through 1958-59, high in consumer interest, Mr Herrmann stated. The schedule will be kicked off in July and August with a "Back to School" promotion, to be followed by coordinated promotions on men's and boys' wear in October, decorative fabrics for Fall in November, resort wear in January, decorative fashions for Spring in April, National Cotton Week in May and Summer Sportswear in June.

The retail promotions, backed by strong advertising, merchandising and point of sale support, will be directed to leading department and specialty stores in the key market areas throughout the country. These include New York, Chicago, Los Angeles, Boston, Philadelphia, Atlanta, Dallas, Kansas City, Cleveland and Detroit.

The Vat Dye Institute is a nonprofit organization composed of vat dye manufacturers in the United States, for the purpose of increasing and expanding the use of vat colors in the textile industry. Its members are: Allied Chemical & Dye Corp (National Aniline Div); American Aniline Products, unit of Koppers Co. Inc; American Cyanamid Co; Arnold, Hoffman & Co, Inc; Chemical Manufacturing Co, Inc; The Dow Chemical Co; E I duPont de Nemours & Co, Inc; General Dyestuff Co, division of General Aniline & Film Corp; Otto B May, Inc; Hoechst Chemical Co; Pharma-Verona Co; and Toms River-Cincinnati Chemical Corp.

Further information on the new promotion program may be obtained from Henry Herrmann, executive secretary, Vat Dye Institute, Inc, Empire State Building, 350 Fifth Avenue, New York 1, NY.

NBIT Open House

Open house days were observed at New Bedford Institute of Technology, Feb 8-9, with more than 2000 people viewing the improvements at the Institute and observing the modern scientific facilities available. A special program was held for secondary school superintendents, principals and guidance officials. Students participated in the program by carrying on experiments and acting as guides for tours.

Renovation of the Institute's Dyeing & Finishing Department has been completed. All equipment has been modernized, and a complete cleaning and painting job carried out. The department will now come under the Research Foundation, a body recently established at NBTI. The department is now set up to handle industrial and governmental research projects, two of the latter already having been completed.

Stein Hall Opens Dallas Sales Office

Stein Hall & Co, Inc opened a new sales office in Dallas, Texas, on March 3, which is said to be the most important expansion of the company's sales coverage in recent years. The Dallas office will be managed by Ronald Goodnight, formerly of the St Louis branch sales office.

The Dallas office covers a territory which includes Texas, Oklahoma, and New Mexico and will handle a complete line of Stein Hall products. The staff members assisting Mr Goodnight are: Max Gorman, George Graham and Pauline Allen.

2nd Textile Market Research Conference

The second Textile Market Research Conference will be held at the Hotel Statler, New York, NY, May 6-7, under the auspices of the National Cotton Council of America.

Specific market opportunities for textiles will be pinpointed in the sessions. Participants will include representatives of firms producing and processing textile fibers, textile merchandisers, trade associations, chemical suppliers to the textile industry, government agencies and other groups.

Progress in the effort to boost sales of textile products also will be reviewed.

The first conference sponsored by the Cotton Council here last year stressed the necessity for improving market research with the objective of aiding the entire industry to better compete for the consumer dollar.

Dexter Establishes Consumer Products Div

The establishment of a consumer products division, with national and foreign sales representation, has been announced by Joseph B Evans, executive vice president of Dexter Chemical Corp, New York.

Among the products now being marketed by the company is a record-cleaning kit named Lektrostat. The kit includes an antistatic detergent, which is said to eliminate static electricity and to dissolve greases and oils from records. The velvet applicator in the kit will clean all foreign matter from record grooves, it is claimed.

"In our process of diversifying, we have studied only fields where we could apply our knowledge of textile chemicals," Mr Evans reported. "The rapidly growing high-fidelity sound industry was one of many offering us a challenge."

Mr Evans story of Dexter's development of a record-cleaning kit follows:

"We were told by recording experts that clean records involved the elimination of static electricity, plus a means of removing dust, lint and dirt from the grooves.

"The problem of removing static, which causes the attraction of foreign materials to the record and also produces noise itself in reproduction, was complicated by the fact that the antistatic chemical had to remove greases and oils and at the same time be of a non-gumming nature. With our long experience with textile antistatic agents we were able to produce such a chemical in our laboratories.

"The major difficulty came in the development of an applicator which would penetrate into the grooves, be soft enough so as not to scratch the vinyl records and still have sufficient resiliency not to mat down. We tried all types of materials from the natural fibers through synthetics. Finally, after continued testing, we learned that a fine synthetic velvet with a dense pile could be obtained to our specifications. However, we discovered that a wiping cloth of this material failed to do a complete job although it was better than anything on the market at the moment.

"After continued study we developed an applicator pad made in the form of a double-faced powder puff and filled with sponge rubber which allowed the pile to penetrate evenly into the grooves and still hold its shape after continued use."

"The initial success of this product," Mr Evans concluded, "confirms our beliefs that there are even more fields in which Dexter can apply its specialized knowledge in textile chemicals to solve major problems."

Lektrostat Record-Cleaning Kit

NYPC Elects Officers

The New York Pigment Club, at its fifth annual meeting, elected the following slate of officers:

President—J Arnold, Paul Uhlich Color Co

Vice President—H H Johnson, H Kohnstamm & Co Inc

Secretary—H U Copland, L & R Organic Products

Treasurer—R Broulliard, General Aniline & Film Corp

Board of Governors—H Hoitzman, Ansbacher-Siegle; D Hambrecht, Ciba Co, Inc; J Loughlin, National Aniline Div; P Ricciardi, E I duPont de Nemours & Co., Inc; J Samko, Collway Color Co; N Segal, Landers-Segal.

Speaker at the March meeting was Herbert Watjen, who discussed "Pigmentation of Plastics and Rubber".

The next meeting of the Club will be held April 10 at Fraunces Tavern, New York, at which time Fred C Petke, vice president in charge of research, Anders Chemical Co, will speak on "Pigments in Printing Inks".

The Club's fourth annual dinner-dance will be held May 10th at the Tavern on the Green, New York.

Cyanamid Announces New Price Reductions

A 10% reduction in the price of aniline oil and related reductions in the prices of dimethylaniline and nitrobenzene was announced Feb 18th by the Organic Chemicals Division of the American Cyanamid Company.

Tank car prices of aniline oil have been reduced from 20 cents a pound to 18 cents a pound. Dimethylaniline is reduced from 30 cents a pound to 28 cents a pound. Nitrobenzene has been reduced from 12 cents a pound to 11 cents a pound.

Solitone Grants Argentine License

Aaron Permut, director of Solitone Laboratories, Hasbrouck Heights, NJ, has announced the granting of a Solitone license to Anilinas Argentinas, SACI of Buenos Aires, Argentina.

The licensee will manufacture Solitone colors and auxiliary products for textile printing and dyeing, and will distribute them in Argentina and Uruguay. Solitone colors are oil-in-water pigmented emulsions for the printing of textiles.

Anilinas Argentinas, SACI has been one of the leading distributors of dyestuffs in Argentina for many years, having succeeded Buzan, SRL three years ago. As an agent for General Dyestuff Co, it maintains modern laboratory and textile technical service facilities in Argentina. Its affiliated company, Anilinas Uruguayas SA in Montevideo will be the distributor of Solitone products in Uruguay.

Pennsalt Begins Barge Shipments of Liquid Caustic to Pittsburgh

With the arrival of a 100,000-gallon barge of 50% standard grade liquid caustic soda from its Calvert City, Ky plant, Pennsalt Chemicals Corp has established new bulk storage and distribution facilities in Pittsburgh to increase service to customers in northeastern US markets. The first barge shipment was made recently to the McClintic-Gordon Co terminal at McKees Rocks, Pa, where Pennsalt has leased bulk storage facilities.

Large bulk shipments to the Pittsburgh area are the result of recent additions to the Pennsalt liquid caustic barge fleet and the expansion of the Calvert City chlorine-caustic plant. This plant, using modern mercury cells, was enlarged last year.

Initial shipments from the McClintic-Gordon warehouse to customers throughout the Northeast will be made by rail tank car. Tank truck shipments are scheduled at a later date.

'58 LTI Alumni Reunion Date Set

The 1958 Reunion of alumni of Lowell Technological Institute will be held Saturday, May 24.

The luncheon and afternoon program will be held at the Institute campus in Lowell, Mass. The evening program and annual banquet will be held at the Andover Country Club, Andover, Mass.

Davidson Industries Inc Commences Operations

Coats & Clark Inc has announced that its new affiliated company, Davidson Industries Inc, has now commenced operations and will locate its sales office and manufacturing facilities at Toccoa, Georgia. J B Clark, president of Coats & Clark Inc, is the president of the new company. Its executive offices will be located at 430 Park Avenue, New York, NY.

The principal corporate purpose of the new Company will be to manufacture and sell the Davison spring used in package dyeing, and other textile machinery and equipment. Davidson springs formerly were imported and were manufactured exclusively by Davidson, MacGregor Company, Ltd of England.

Joe F McMillan, formerly of Coats & Clark, has been appointed to head the selling organization of the new company. Eric B Davidson, head of Davidson, MacGregor Company, Ltd, is a vice president and director of Davidson Industries and is presently in this country to assist the new company in its start-up operation.

Other officers of the company, all associated with Coats & Clark are J Bains and W C Wheeler, vice-presidents, W D Seidler, secretary, and A McFarlane, treasurer.

Japanese UN Delegate Addresses Phi Psi Met Chapter

The Metropolitan New York Alumni Chapter of Phi Psi Fraternity heard Japan's economic story direct from a Japanese authority on February 11 when Masayoshi Kakitsubo, Japanese U N delegate, addressed members and guests at a regular meeting in New York.

In the discussion period which followed Mr Kakitsubo's remarks, the U N delegate was assisted by Masayuki Okita, president of Kanebo New York, Inc, selling subsidiary of Kanegafuchi Spinning Co, Ltd, with 33 mills handling cotton, wool, silk, and rayon yarns, fabrics, and finishing. Douglas F Grady, Thorndike Deland Associates, chapter president, presided. Head table guests included George F Long of Harchem Division, Wallace & Tiernan, national president of Phi Psi; Benjamin F Bellemere of Bellemere Chemicals Co, national secretary; Roger F Lewis of Union Carbide Chemicals Co, vice president of the New York chapter; and James H Kennedy of Bruce Payne & Associates, Inc, director of public relations of both the national and the New York organizations.

Feature of Rothschild—Young Quinlan's windows exhibiting "The Spotless Look" in women's wear was chemical mixing machine (in plaid tower, background), which periodically stirred red-colored oil (top layer), green-colored water (middle layer), and colorless Scotchgard brand stain-repeller together. The three would separate out, as shown here, demonstrating both oil- and water-repellency of the stain-repeller.

"Spotless Look" Store Promotion Begins

Featuring contests for both sales personnel and customers, the first of more than 100 national store promotions of "The Spotless Look" in women's suits and coats opened at Maurice L Rothschild—Young Quinlan Co, Minneapolis, Minn, last month.

Six of the store's Nicollet Avenue windows drew attention to Zelinka Matlick fashions of Forstmann woolens treated with Minnesota Mining and Manufacturing Co's Scotchgard brand stain-repeller. The uniforms of Northwest Orient Airlines stewardesses, which were designed by Rothschild—Young Quinlan, are said to be the first of any airline to be treated with the stain-repeller.

"The Spotless Look" is the theme for the stain-repeller, which is claimed to be the first in the history of the textile industry to impart not only water-repellency, but oil-repellency as well to woolen, worsted, and worsted-synthetic blend fabrics.

300 Attend 57th PTI Alumni Banquet

Approximately 300 alumni and friends of the Philadelphia Textile Institute attended the PTI Alumni Association's 57th Annual Banquet last month in the Grand Ballroom of the Warwick Hotel, Philadelphia, Pa.

Guest speaker at the affair was Michael Daroff, president, H Daroff & Sons, Inc, Philadelphia. Other speakers included Bertrand W Hayward, PTI president, who delivered his annual "State of the Institute" message: William Maynard, alumni president, who served as toastmaster; and William Popp, Alumni Fund chairman.

R&H Reduces Prices of Nonylphenol

A reduction of 5 cents a pound in the tankcar and tanktruck price of Rohm & Haas Co's nonylphenol became effective March 1.

Drum and less-than-drum prices were reduced 4½ cents a pound, and a differential of 2 cents a pound was added for West Coast shipments. The new prices are as follows: tankcar and tanktruck, 19½ cents a pound; carload and truckload (400-lb drums), 22 cents; less than truckload drums, 23 cents; less than drum quantities, 33 cents.

GFB Weathering Tester

The GFB Weathering Tester, Xenotest WPL 394 model, a product of G F Bush Associates, Box 175, Princeton, NJ, is a research, testing, and production control device for accelerating weathering effects of natural sunlight, humidity, rain, and temperature in any repeated program on all materials, coated or otherwise. Among such effects are fading, photochemical changes, and discoloration of textiles, dyes, finishes, etc.

The tester's synthetic sunlight is produced by the same lamp as in the GFB Light-fading Tester, Xenotest PL393 model.

The automatic, preselected weathering program is said to more nearly duplicate atmospheric weather conditions to which materials are subjected, because of controlled humidity and rain, in addition to the usual controlled sunlight and temperature as in the GFB Light-fading Tester.

Shape, size, general construction, operation, performance, and controls are approximately the same as for the GFB Light-fading Tester; additional are controlled humidity and rain, including items such as pumps, reservoirs, nozzles, and piping, contract hygrometer and programming controls.

Information Bulletin 158 gives general description, design features, characteristics, and information on auxiliary equipment for the GFB Weathering Tester and the GFB Light-fading Tester.

• NAMES IN THE NEWS •

Hagan

Callaway Mills, Inc has announced the retirement of **John Francis Hagan,** a prominent textile technical expert, on March 1st. He had served as assistant to the president, R D William Jr, since 1946.

Mr Hagan has been responsible for keeping Callaway Mills, Inc up on the latest textile developments and technology. He has been charged also with the training and education of sales personnel in industrial fields and channeling information throughout the organization.

Mr Hagan's career includes service as a member of the Textile Committee to Europe for the Quartermaster General; General Arbitration Council for the Textile Industry; Textile Advisory Board on Quartermaster Research & Development of the National Academy of Sciences; and the Committee on the Revision of Commercial Standard, Association of Cotton Textile Merchants. He has been active in AATCC, AATT (of which he is a past president), ASME, and ASTM.

Mr & Mrs Hagan plan to spend winters in Florida and the warmer months at their home in New Jersey.

Bernard H Jacobson, vice president and director of Food Machinery and Chemical Corporation, will be the recipient of the 1958 Honor Award of the Commercial Chemical Development Association. The award will be presented to Mr Jacobson on March 27 at an Association dinner in his honor at the Hotel Statler, New York.

This award, which is presented annually for outstanding achievement in the field of commercial chemical development, will be given to Mr Jacobson in recognition of his pioneering work in the development of plasticizers for vinyl resins and related products.

Genevieve M Smith, manager of the New York Textile Laboratory, Sears, Roebuck & Co, has been elected treasurer of the New York State Home Economics Association.

George E Sinkinson, who has served Sayles Finishing Plants, Inc, and its two subsidiaries for thirteen years as president, has been elected chairman of the board.

Elliot Broadbent succeeds Mr Sinkinson as president of the parent company and Sayles Biltmore Bleacheries. Inc, while **Richard P True** has been elected president of Special Fabrics, Inc.

Joseph P Quinn, vice president and plant manager of the Saylesville Bleachery, succeeds Mr Broadbent as executive vice president of the parent company and Sayles Biltmore Bleacheries, Inc.

Other officers of both companies were reelected as follows: **Cornelius J Quinn,** vice president; **Frederick McAlpine,** vice president, secretary, and treasurer; and **Edgar R Coddington,** vice president and controller.

Moore

Dyer

Bozzacco

C P Moore and **R E Dyer** have been appointed special representatives for the Chemical Division of The Goodyear Tire & Rubber Co, and **F A Bozzacco** has been named sales engineer with the Division's coatings department.

Mr Moore will service accounts in the Carolinas from headquarters in Charlotte, NC, while Mr Dyer will provide sales and technical service to accounts in the mid-Central states from headquarters in Cleveland.

Mr Bozzacco will be directly responsible for technical service activities concerning Pliolite rubber latices.

Menkart

John Menkart, formerly of the Textile Research Institute, has joined the staff of Harris Research Laboratories. Inc, Washington, DC. He will direct projects dealing with keratin fiber chemistry.

Nelson S Knaggs, vice-president in charge of sales of the Hilton-Davis Chemical Co, Cincinnati, has been elected to the board of directors of the Explorers Club.

Mr Knaggs was named to serve a regular three-year term.

Mr Knaggs began exploring in 1941 and was awarded membership in the Explorers Club in 1948.

Appointment of **Martha E Jungerman** as consultant in education to the Wool Bureau has been announced.

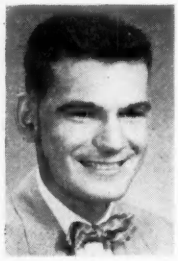
Miss Jungerman, an associate professor at the Philadelphia Textile Institute and a staff instructor since 1945, will continue in that capacity until July 1. She will then become a full-time member of the Wool Bureau staff with the title of director of education.

George Leitner has joined the staff of the Textile Pigment Research Laboratories of the Geigy Chemical Corp at Ardsley, NY.

Mr Leitner was formerly chief of the Organic Laboratory at Nuodex Products Co, Elizabeth, NJ.

The Cravenette Company, USA, Hoboken, NJ, has announced the addition of a new sales representative, **Paul J Lombardi,** who will be calling on mills and finishing plants in the New England area.

Mr Lombardi was a technical sales representative for a prominent pharmaceutical organization before joining Cravenette. He has recently completed an extensive technical training program in his new field.



Wright

John Wright Jr has joined the sales staff of Arnold, Hoffman & Co, Inc. He will service the company's accounts in the New York City area, Connecticut, and Western Massachusetts.

Mr Wright formerly was employed as a chemist in Arnold, Hoffman's Technical Service Laboratories at Teterboro, NJ. Subsequently, he gained further practical experience with Millville Mfg Co as assistant production control manager, and with Abbeville Mills Corp as a laboratory technician.

The appointment of four division managers for chemical sales, the first step in the company's program to expand 1958 chemical sales, was announced recently by Reichhold Chemicals, Inc.

W D Conrad will manage chemical sales in RCI's Central Atlantic Division from offices at the firm's Charlotte, NC, plant. He formerly held the position of technical sales representative for adhesive resins in that division.

The new chemical sales manager in the Pacific Southern Division is **W A Gerhardt,** a member of the firm since 1944, and a former divisional sales manager. His offices will be at RCI's Azusa, Calif, plant.

G D Lamont has been named chemical sales manager in the Midwest Division with offices at the company's Detroit plant. Lamont joined the firm in 1947 and last year was appointed district sales manager for the Detroit sales territory.

R J Read has become Northeastern manager of chemicals sales and work from RCI's Ballardvale, Mass, plant.

W H Sheltmire has been named manager of the hypochlorite products department, Industrial Chemicals Div, Olin Mathieson Chemical Corp. He had been assistant manager for hypochlorite products since 1952.

A E Wennerstrom, former manager of hypochlorite products, is now senior advisor in the same department.

Raymond W Hess retired at the end of February as coordinator of pollution research for National Aniline Division, Allied Chemical & Dye Corporation after a career of nearly 40 years with the company.

Dr Hess plans to continue his activities in the field of pollution abatement as a consultant. His appointment as consultant-executive to the Hamburg, NY Water Board was recently announced.

Dr Hess for the past 20 years has been occupied with coordinating National Aniline's activities relating to operating improvements and waste problems. This work has involved research on characterizing plant wastes, their effect on streams and atmosphere and methods of treatment and control, and in recent years has extended to new plants of the Division in Virginia and West Virginia. Prior to this work he was active in research and development of dyestuffs and other products at National Aniline's Buffalo plant.

For his work in pollution abatement, Dr Hess has received many commendations and honors, including the Schoellkopf Medal, awarded in 1956 by the Western New York Section of the American Chemical Society. The Arthur Sidney Bedell Award was presented to him in January 1958 by the Federation of Sewage and Industrial Wastes Associations. On February 18, 1958, Dr Hess received a special award from the Manufacturing Chemists' Association at a luncheon held in Washington, ". . . in appreciation of his many years of dedicated service" in the field of water pollution abatement.

Cayce

The Annual Meeting and Dinner of the Twenty-Five Club of the Dyestuff & Chemical Division of General Aniline & Film Corporation was held in New York Friday, February 21, at which time, **C C Cayce,** branch manager at Charlotte, NC, was installed as president of the Club. New members initiated were **Louis R Waddey,** branch manager at Chattanooga, Tenn, and **J Hagood** of the Charlotte office, to bring the total active membership to over 150 members.

Bainbridge

John P Bainbridge Jr, formerly associated with Monsanto Chemical Company, has joined Penick & Ford, Ltd, Inc, as assistant sales service manager to **J E Killinger.** His headquarters will be at Cedar Rapids, Iowa.

American Cyanamid Co has announced that **Luther E Beiswanger** has been named director of engineering for the Organic Chemicals Div and **Robert A Olson** has joined the Philadelphia sales office of the Pigments Div.

Mr Beiswanger has been with Cyanamid since 1940 in various technical and managerial posts.

Mr Olson, who will be responsible for pigment sales in eastern Pennsylvania, Delaware and Virginia, was formerly with the Pigments Division sales office in Los Angeles.

Gus Englund, formerly vice president of the Prior Chemical Corp, New York, NY, has joined **F H Ross & Co** as manager of national sales.

Mr Englund will make his headquarters in Charlotte, NC.

Sinclair Chemicals, Inc, a wholly owned subsidiary of Sinclair Oil Corp, recently announced the appointment of **Robert L Hart** as district sales representative with headquarters in Philadelphia, Pa.

Mr Hart joined Sinclair Chemicals, Inc in 1954 as a sales engineer located at Chicago, Ill.

A $6,000 fellowship, provided by the Glycerine Producers' Association for support of research contributing to the knowledge and understanding of glycerine and its reactions, has been awarded to **Stanley Levy,** a graduate assistant in Chemistry at Case Institute of Technology, Cleveland, Ohio.

The fellowship provides a $3,540 stipend, full tuition and expenses for the student. It will run for a period of 17 months, following which, renewal will be on a year-to-year basis.

Ciba 25-Year Club

Faust

Harold Faust has been elected president of Ciba Co, Inc's 25-Year Club, succeeding **Fred Schlapp**, the 1957 incumbent.

The Club, with a membership comprising representatives from all offices and service centers of the Company, held its annual dinner recently at the Yacht Room of the Sheraton-Astor Hotel, New York.

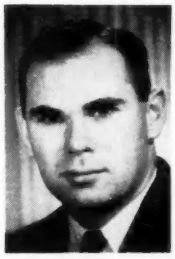
Seaboard Chemicals, Inc, Salem, Mass, has announced the appointment of **Roy E Pyburn** as technical field representative for the newly formed Elastochem Division.

Mr Pyburn was formerly employed by the U S Testing Company, American Resinous Chemicals Corp in the Latex Development Section, and Foss Chemical Company in the capacity of chief chemist.

The Elastochem Division will specialize in the manufacture of tie-coats, paper and fabric saturants, specialty adhesives, fabric and rug backings, dip coats and binders.

Metro-Atlantic, Inc, Centredale, RI, has named **Edward F Starke** as director of merchandising for all of the company's branded finishes. He will make his headquarters in the New York office at 10 East 39th Street.

Mr Starke was formerly assistant to the president of Greenwood-California Fabrics, Inc.



Hoban

The appointment of **Robert F Hoban** as laboratory chemist in Cincinnati, O, has been announced by Sandoz, Inc.

Mr Hoban returns to Sandoz after two years of service as a chemical laboratory technician for the U S Corps of Engineers.

Assignment of **George A Stanley** to the Dow Chemical Company's New York textile fiber sales office has been announced. He will work in the merchandising section located in Dow's offices at 45 Rockefeller Plaza.

Stanley, who previously served in the textile fibers department development group at Warwick, Va, will cover cutters, retail and mill sales contacts in the New York area for Zefran, Dow's new textile fiber.

Stanley joined Dow in 1955 and worked in the textile development group at company headquarters in Midland, Mich, before transferring to the new Dow fiber production and marketing center in Virginia.

Ciba Co, Inc has appointed **Frank P Russell**, an internationally known leather chemist, to head its technical department serving the leather trades. Mr Russell served 12 years with Imperial Chemical Industries Ltd, Manchester, England, as deputy manager of the Leather Service Dept.

Obituary

JAMES L BERSTON, 64, retired president of Zinsser & Co Inc, division of Harshaw Chemical Corp, Hastings-on-Hudson, NY, died of a heart attack on February 13th, while attending a dinner of the Newcomen Society of North America at New York's Hotel Pierre.

Mr Berston, who retired Jan 1st, joined the Zinsser firm in 1920 as a research chemist. He became general manager and president in 1932. The Zinsser company merged three years ago with Harshaw of Cleveland.

Born in Yonkers, NY, May 2, 1893, he was a graduate of Yonkers High School in 1912 and Cornell Univ in 1918, having been colonel of the cadet corps in college. He served in World War I as a lieutenant in the U S Army Coast Artillery.

He is survived by his widow, Mary; a son, James W, and a daughter, Joan.

JAMES BARR, formerly sales manager of David Gessner Company, manufacturer of textile finishing machinery, Worcester, Mass, died

Barr

February 12th in Miami, Fla of a heart attack. He retired from Gessner in 1953 and moved from Worcester to Florida.

Mr Barr was born in Johnestone, Scotland, July 6th, 1880. He came to the United States and to Worcester in 1901 and married Clementina Culbert of that city. He went to work for David Gessner in 1903 and continued his association uninterrupted for fifty years. He was a member of the Royal Order of Scot Clans.

ABRAHAM MOSCOWITZ, chief chemist for L Sonneborn Sons, Inc, Belleville, N J plant, who served 29 years with that Company, died on February 11. He was 62 years old.

Mr Moscowitz, a member of AATCC, lived in Nutley, N J. He was a graduate of the Polytechnic Institute of Brooklyn and received his chemistry degree in 1918. During World War I, he served as a lieutenant in the Quartermaster Corps.

He was born in Istanbul, Turkey, and was brought to this country as a small boy. His survivors include his wife, a son, a daughter, a sister and two brothers.

ELMER C CARLING, sales manager of the Pigments Division, American Cyanamid Company, died Sunday, January 19, following a short illness. He was 48 years of age.

He spent his entire business life in the pigments field working with Cyanamid and earlier with companies that later became a part of the American Cyanamid Company.

In 1947, Mr Carling established an eastern regional sales office in New York City for the pigments department of Cyanamid, then a part of the Organic Chemicals Division. In this capacity he was responsible for pigment sales in the metropolitan New York, New England, Philadelphia and Baltimore areas.

He became assistant sales manager of the entire pigments department in 1949, and was named sales manager of the later-formed Pigments Division of Cyanamid in 1954.

BOOK REVIEW

THE MODERN TEXTILE DICTIONARY

George Linton
Duell, Sloan and Pearce, Inc,
New York (1957)
$12.50; xxii + 772 pages

As a writer of dictionaries, George Linton is no tyro. He has collaborated in the making of three other compilations similar to this book, but smaller.

Having been born and brought up in textiles, so to speak, it is to be expected that he would bring out a creditable book, and he has.

From AAL, which is an Indian plant whose roots yield a red color, to ZULU CLOTH (on page 769), a well-textured twill-woven cotton material used as a base in embroidery, the book is full of interesting matter. It should make good reading to a host of people, both inside and outside of the textile industry.

As a textile chemist and colorist, the reviewer is interested mainly in textile chemistry and all that pertains to it, preparation of cloth of all fibers and combinations of fibers, bleaching, dyeing, padding, printing and finishing. So we looked up a few items bearing on that important subject, and we concluded that, if any fault could be found with this splendid book, it was in this department.

For instance, reading on the subject of "PERKIN, SIR WILLIAM HENRY", we find that his entire life and achievements are covered in ten words and the incorrect year 1857, it should be 1856. But when it comes to the matter of the biography of Joseph Marie Jacquard and the Jacquard Machine, this takes up two columns.

Both men made revolutionary discoveries, both should be honored, but we feel they both deserve to stand *on the same step*, as they say in theatrical circles, they should have "equal billing".

"Flock printing" is defined as the application of dots to fabrics. This style is no longer confined to the printing of dots; it is capable of producing a large variety of objects.

The tremendous increase in the manufacture of tufted carpets, it seems to us, should entitle this article to a place in the dictionary.

Under the heading of "Yellowing", mention is made of the yellowing of woolens, worsteds and cottons. What about silk? And some of the man-made fibers too?

"Paisley", as we understand it, is really a Persian pattern adopted by the Paisley (Scotland) woolen manufacturers in their woolen shawls, and one of the outstanding characteristics of this type of design is the Persian "palm", a motif roughly approximating the shape of some palm leaves.

When we were in the textile printing business, one of our "high specialties" was warp printing. For this reason we would have liked to see a little more information published about this charming style, which involves close cooperation between the manufacturer and the printer to ensure the optimum result.

Under "Piece Dyeing", the statement is made "dyebeck, box, jig, or some other form of *continuous* machine. This is obviously a slip, as all these machines are for handling piece goods by the batch method.

Included in the department dealing with dyeing could well have been "package dyeing" and skein dyeing, as it was always known in Paterson silk dyehouses.

Worthwhile additions to the Appendix would be Harris' "Handbook of Textile Fibers" 2nd edition, and the AATCC "Technical Manual & Year Book".

Dr Linton has provided the industry with a useful reference book, written in readable form which should meet with ready acceptance among textile writers, teachers, technicians, manufacturers, salesmen, in fact anybody connected with the manufacture, finishing, converting and cutting-up of textile fabrics. We would not care to be without it.—Q.E.F.

Patent Digest—

(Concluded on page 202)

tion to a rayon fabric. After being subjected to AATCC Wash Test No. III A, the fabric showed warpwise shrinkage of 0.3% against 8.0% for the control sample. The loss of tensile strength was determined to be 4.5%.

Among the references cited by the Patent Office:

USPat 2,243,682 (Imp Chem Ind/1941): imparting a durable finish to cellulosic material by impregnating with a high fatty acid substituted quaternary ammonium compound.

USPat 2,351,581 (Rohm & Haas): see above.

USPat 2,680,057 (Deering Milliken/1954): enhancing the creaseproofness and dimensional stability of organic textiles by impregnating with cyclopropyl-substituted pyridinium compounds, followed by drying and baking [cf *Am Dyestuff Reptr* 44, 369 (1955)].

USPat 2,681,342 (Onyx Oil & Chem Co 1954): see above.

EMKAY CHEMICALS FOR YOUR TEXTILE PROCESSING

EMKAY MANUFACTURES:

• Emkabase	• Emkalite	• Emkaperm	• Emkaterge	• Rexogel	• Rexopon	• Rexoslip
• Emkacide	• Emkalon	• Emkapon	• Emkawate	• Rexogum	• Rexoscour	• Rexowax
• Emkafix	• Emkalube	• Emkasize	• Rexobase	• Rexole	• Rexosolve	• Rexowet
• Emkafol	• Emkanet	• Emkasol	• Rexobond	• Rexolene		
• Emkagen	• Emkanol	• Emkatard	• Rexoclean	• Rexoloid		
• Emkalane	• Emkapel	• Emkatex	• Rexodull	• Rexolube		
• Emkalar	• Emkapene	• Emkatol M	• Rexofos	• Rexopene		

MANUFACTURING CHEMISTS EMKAY CHEMICAL COMPANY EMKA PRODUCTS-REXO

EMKAY CHEMICAL COMPANY
319-25 Second St., Elizabeth, N. J. ELizabeth 2-7053 - 7695